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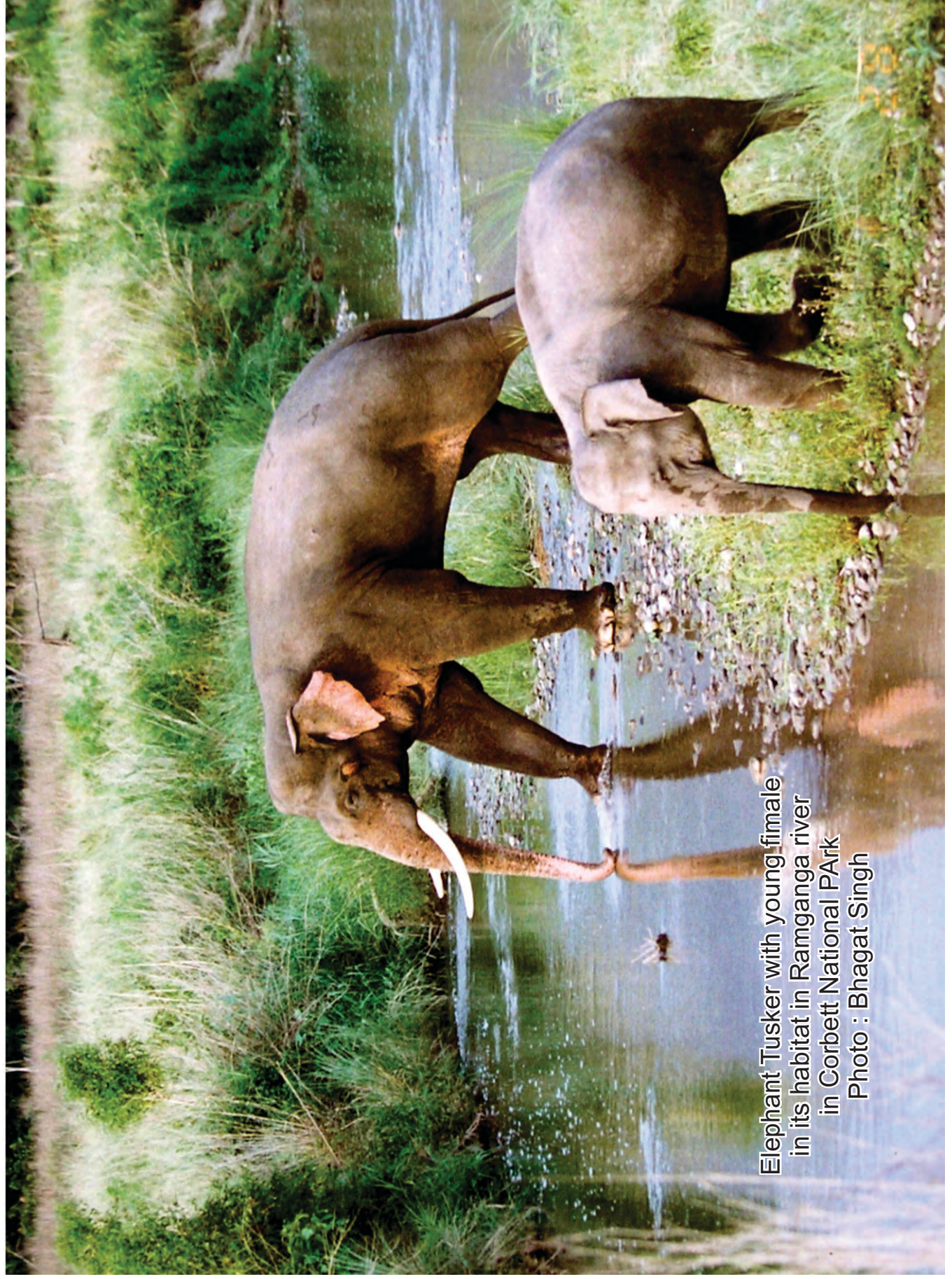
JOURNAL OF

The Wildlife Preservation Society of India

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Musk Deer at Deoriya Tal
in Kedarnath WLC
Photo : Bhagat Singh





Elephant Tusker with young female
in its habitat in Ramganga river
in Corbett National Park
Photo : Bhagat Singh

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Editorial

With degradation, fragmentation and reduction in forest cover it is becoming increasingly difficult to conserve wildlife despite best of the management techniques available today. The traditional protected area management is being attempted in isolation and habitats are becoming insulated one after the other. The landscape approach of management, which is most desirable, not only for conservation of large mammals but also for environmental concerns, are being talked about in theory but in practice the ever increasing hunger of mankind for unsustainable development is making the concept difficult every passing day. Large scale mining in forest areas is the biggest threat which involves a nexus between politicians and mining mafia. Ever expanding urbanization, infrastructure development, hydropower and irrigation projects are few other examples among many which are responsible for fragmentation, reduction and degradation of wildlife habitat. An ecosystem which has attained a stability after hundreds of years of succession, once lost cannot be recreated. Close dependence of living organisms on each other and stakes of man being highest in this interrelationship, it is high time that we should now realize the grim reality and try to reverse the trend in favor of restoration of natural processes. With every passing day the situation is worsening and the time is not far when we may feel sorry for our own existence in this beautiful planet which we have been mistaking as our own kingdom. Each one of us can contribute to reverse the dangerous trend by remembering the famous saying of Mahatma Gandhi that we have enough for our needs but not enough for our greed.

A.S Negi

Important Notice

As decided in the last executive committee meeting of WPSI, a trip of WPSI life members to Corbett Tigers Reserve has been planned from 9th to 11th march 2014. 15 members only will be accommodated for the trip on first come first serve basis. Members may send their willingness by email to asnegi1943@gmail.com. The confirmations will be sent by mail. The travel and staying charges will be borne by the society. There is no provision for inclusion of the family members.

President WPSI

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Air Pollution Control : Acid Gas Injection Techniques

***Sanju Borana and L. S. Rajpurohit**

Abstract

The aim of this paper is to help create an awareness in reducing the release of acidic gases in atmosphere and discuss briefly about the “acid gas injection technique” being adopted now a days. The paper is written keeping in view the readers of different discipline and is therefore more of popular than technical. To create a background for the need of “Acid Gas Injection Techniques”, brief introductions to air pollution, acid gas & methods to reduce the “air pollution” are discussed in the initial paragraphs. Acid rain & its impacts are also discussed in the up coming paragraphs. Finally, an introduction to “Acid Gas Injection Techniques” is described. The subject is addressed only peripherally with reference to natural gas & petroleum crude, however, the techniques can be applied to other process, petrochemical industries & power plants. The geological design of acid wells and suitability have not been discussed in this paper.

Keywords

Geological disposal, LNG (Liquefied Natural Gas), CNG (Compressed Natural Gas), EPA (Environmental Protection Agency), WHO (World Health Organization), CFC (chlorofluorocarbons)

Background

Hydrogen sulfide and carbon dioxide are common contaminants of natural gas. The sulfur components are also present sometimes in the crude oil. The percentage of contamination varies from place to place, depending upon the geological contents of the well. These contaminants are removed in order to produce commercial gas. Hydrogen sulfide and carbon dioxide are called “acid gases” because when dissolved in water they form weak acids. Hydrogen sulfide must be removed from natural gas because of its high toxicity and strong, offensive odor. Carbon dioxide is removed because it has no heating value. Another reason why these gases must be removed is because they are corrosive.

Flaring of these gases into atmosphere is very harmful to environment. The acidic gases released to atmosphere, returns back to earth in the form of “acid rain”. If there is a large amount of acid gases it may be economical to build a Claus-type sulfur plant to convert the hydrogen sulfide into the more benign elemental sulfur. For small acid gas streams sulfur plants are not feasible. In the past it was permissible to flare small amounts of acid gas. However, with growing environmental concerns, such practices are avoided. It is already

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proven and is beyond doubt that CO₂ is harmful to the environment. Engineers are increasingly facing with the problem of disposing of CO₂.

Acid gas injection has become an established environmental friendly way to dispose of unwanted acid gases. The goal must be to prevent future pollution by reducing the releases of pollutants into the environment to a near zero level. Since, the world is getting more & more industrialized and getting developed, use of fossil fuels are increasing at an alarming rate.

There are international bodies like Environmental Protection Agency (EPA), which keeps on monitoring the air pollution and in particular acid gas concentrations. The EPA, aims to educate users and increase their awareness of the environment.

Air Pollution

Air pollution refers to the discharge of harmful gases and dust into the atmosphere. When these harmful substances enter the air around us, they may cause irreversible damage to humans and to our environment. Some of the main air pollutants are: Sulfur dioxide (SO₂), Hydrogen Sulfide (H₂S), Carbon monoxide (CO), Ozone (O₃) and Nitrogen dioxide (NO₂).

The Sulfur dioxide is responsible for acid rain. The Carbon monoxide enters the blood stream and reduces the delivery of oxygen to the body organs and tissues. Also, its elevated levels may result in impairment of visual perception, work capacity, manual dexterity, learning ability and performance of complex tasks. The Ozone damages the lung tissues and reduces lung functioning. The Ozone also reduces agricultural crop yield; causes foliar damage in many crops and trees. The Nitrogen dioxide contributes to acid rain. The Nitrogen dioxide also irritates lungs and lowers resistance to respiratory infections e.g. influenza.

According to the World's Health Organization, each year about tens of thousands of people die in the world's major cities due to breathing of poor quality air. As many as one billion people around the world are regularly exposed to pollution levels up to 100 times more than WHO guidelines.

Causes of Air Pollution

Air pollution can be caused by two main components, natural and human factors. Natural factors such as volcano eruptions and natural forest fires often cause tons of ash and tiny air pollutants to be released to our earth's atmosphere. However, the human factors are much more devastating.

As we are all aware, air pollution takes many different forms and arises from a variety of sources. In terms of overall range and extent of impacts, however, it is our opinion that burning of fossil fuels (coal, gasoline, etc.) is the single largest source of air pollutants. These fuels cause smog, acid rain, soot and particulates increases, greenhouse gas emissions, and dispersal of some heavy metal contaminants.

Fossil fuels are widely used for heating, transportation, electricity generation, manufacturing and other industries. When fossil fuels such as coal and oil are burnt to produce electricity,

large quantities of sulfur dioxide and nitrogen dioxide (gases that are responsible for acid rain) are released into the air.

Vehicles use either diesel or petrol to generate power and, as a result, produce fumes that contain lead and carbon monoxide which pollute the environment and harm living things. Thus, they are used extensively in our society and their use is difficult (but not impossible) to curtail. One of the example to replace diesel & petrol, is the use of CNG. (Compressed Natural Gas). CNG is a sweet gas. The CNG is used in Delhi now for all the public buses, taxis etc. It is a welcome start. The replacement of diesel & petrol with a cleaner fuel can be done in the phased manner. Further, various measures can be taken to help make fossil fuel burning both cleaner and more efficiently but this comes at some monetary cost. Until we find cleaner alternatives to the present fossil fuels burning methods, most air pollutants plaguing the world today will continue to be a problem in the future.

Control of Air Pollution

The first step in any pollution control is the prevention to its cause itself. There is a saying "Prevention is better than cure." The effort must be to assess and change processes to eliminate the possible generation of air pollution. This is known as "source reduction." In the instances where source reduction is not considered feasible, various other techniques are used to reduce the impact..

REDUCE VEHICLE EMISSIONS : The use of cleaner fuel e.g. CNG is one example. Alternatively, it can be done by installing catalytic converters in every car so that the amount of toxic gases released is reduced. Unfortunately, it all comes with cost. A more effective way is to reduce the number of vehicles on the road. Another way is to encourage the public to take public transport.

REDUCE INDUSTRIAL & POWER PLANT EMISSIONS : Industries can reduce the amount of air pollutants they release by installing scrubbers & other suitable equipment, which are capable of removing up to 90 % of sulfur dioxide from waste gases.

USE RENEWABLE ENERGY : Renewable energy, such as wind and hydroelectric energy, does not pollute, unlike traditional sources of energy that depends on the combustion of fossil fuels.

REDUCE THE USE OF CFCS : The effects of ozone depletion are disastrous. CFCs, or chlorofluorocarbons, is the gas that is responsible for ozone depletion. By reducing the emission of CFCs, we can significantly slow down the rate of ozone depletion. Chlorofluorocarbons (CFCs) are nontoxic, nonflammable chemicals containing atoms of carbon, chlorine, and fluorine.

Acid Rain Phenomenon

Gases like nitrogen dioxides and sulfur dioxide and particles formed from fossil fuel burning react with water and oxygen in atmosphere in presence of sunlight to form mild acids.

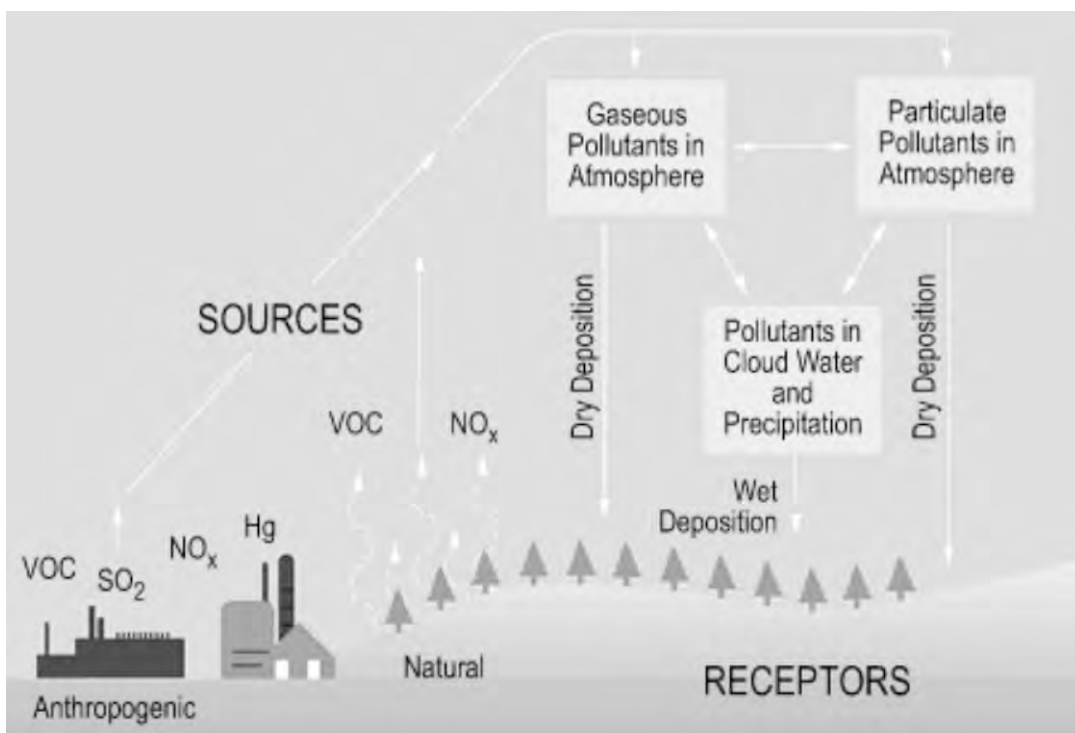
"Acid rain" is a broad term used to describe several ways that acids fall out of the

atmosphere. A more precise term is acid deposition, which has two parts: wet and dry.

Wet deposition refers to acidic rain, fog, and snow. As this acidic water flows over and through the ground, it affects a variety of plants and animals. The strength of the effects depend on many factors, including how acidic the water is, the chemistry and buffering capacity of the soils involved, and the types of fish, trees, and other living things that rely on the water. Dry deposition refers to acidic gases and particles. About half of the acidity in the atmosphere falls back to earth through dry deposition. The wind blows these acidic particles and gases onto buildings, cars, homes, and trees. Dry deposited gases and particles can also be washed from trees and other surfaces by rainstorms. When that happens, the runoff water adds those acids to the acid rain, making the combination more acidic than the falling rain alone.

Prevailing winds blow the compounds that cause both wet and dry acid deposition across state and national borders, and sometimes over hundreds of miles.

The acidic particles and gases can also aggravate respiratory ailments like asthma and bronchitis.



Scientists discovered, and have confirmed, that sulfur dioxide (SO₂) and nitrogen oxides (NO_x) are the primary causes of acid rain. Most of SO₂ and NO_x comes from electric power generation that relies on burning fossil fuels like coal. Acid rain occurs when these

gases react in the atmosphere with water, oxygen, and other chemicals to form various acidic compounds. Sunlight increases the rate of most of these reactions. The result is a mild solution of sulfuric acid and nitric acid.

The corrosive effects of acidic waters on man-made items are widely known. On the other hand, we only can speak mostly in generalities when discussing the effects of acid-rain on natural environments. The short-term danger from acid rain is mostly to forest and lake ecosystems, which are very sensitive to chemical imbalances in their environment. With the loss of these ecosystems that effectively moderate the pH of surface run-off water in many areas, the effect of acid rain on local water supplies could become more pronounced in the future.

Acid Gas Injection Techniques

There are many processes which are used in the plants to remove the sulfur contents. The process is called “Sulfur Recovery”. The Sulfur recovery converts hydrogen sulfide in sour gases and hydrocarbon streams to elemental sulfur. The most widely used recovery system is the Claus process, which uses both thermal and catalytic-conversion reactions. A typical process produces elemental sulfur by burning hydrogen sulfide under controlled conditions. Knockout pots are used to remove water and hydrocarbons from feed gas streams. The gases are then exposed to a catalyst to recover additional sulfur. Sulfur vapor from burning and conversion is condensed and recovered. There is hardly any commercial demand for sulfur and it is un-economical to store and transport the sulfur, since there are very few buyers.

A new technology called acid gas re-injection has emerged over the past ten years as an effective way of ensuring that acid gases are not emitted into the atmosphere. This technology involves compressing the acid gas and injecting it into a suitable underground zone.

Essentially, the sulfur compounds and CO₂ are permanently stored in the deep geological formation preventing their release to the atmosphere. Therefore most acid gas re-injection projects can be considered as existing examples of CO₂ geological storage projects. These projects provide important practical experience with CO₂ storage. In addition, this technology could be extended to capture a significant fraction of the natural gas-associated CO₂ stream at low cost.

Major advantages of the “Acid Gas Injection Techniques” is that there are effectively no atmospheric emissions. Sometimes, it may result in large cost savings by eliminating a sulfur recovery plant. However, initial studies need to be made and it largely depends upon the concentrations of the sour gas. It is also a safe and efficient method of acid gas disposal.

General Operating Parameters for Acid Gas Injection Systems

Looking to the advantages of AGI techniques for “no emissions”, it is becoming more and more appealing to oil and gas producers to adopt this technique. There are “Regulatory

Agencies” in some countries like Canada, which will license acid gas injections based upon the concentrations. Generally, the maximum H_2S content of the injected acid gas, which varies between 5% and 97% mole fraction is allowed. The rest of the constituents of the “injected acid gas” will be mostly CO_2 , with a few percent C+ gases for the balance. The actual average composition of the injected acid gas varies from 83% H_2S and 14% CO_2 to 2% H_2S and 95% CO_2 . The maximum approved wellhead injection pressure varies between 3,750 and 19,000 kPa. Approved daily injection rates vary between 2,000 and 900,000 m³/day. Maximum allowed injection volumes vary between 6×10^6 and $1,876 \times 10^6$ m³. Based on the estimated total injection volume and aquifer or reservoir capacity, the acid gas injection sites are planned to operate for periods of 10 to 25 years or longer.

Acid Gas Injection Process Overview

There are primarily three blocks to an acid gas injection scheme. These are ; 1. Multi Stage Acid Gas Compressors, 2. Pipeline and 3. Acid Gas Injection well. There is sometimes dehydration units also required. The design factors of the process need to consider the water content of the acid gas, possible formation of the hydrates, density and viscosity of the acid gas. The acid gas is an wanted by-product in a process plant, which can be a natural gas processing or other petrochemical plant .

The natural gas or crude from the well consists of crude, water & natural gases. The natural gas contains sour gas. The crude & natural gas is sweetened and during this process acid gas is also produced. The sweetening process of natural gas consists of the removal of hydrogen sulfide and carbon dioxide. The sweetened gas, with the H_2S and CO_2 removed, is saturated with water.

Water is associated with natural gas from the reservoir, through production and processing. Water is removed at various stages in the process. The acid gas is injected as “dry” or “wet” or “mixed with water”, purely depends upon the geographical nature at the well. There are a few sites in Canada, where the acid gas is dissolved in water prior to injection, and the resulting weak acidic solution (“sour water”) is injected. While, at a few other sites, wet acid gas (i.e. acid gas with free water present) is injected. However, Dry acid gas (i.e. with no free water present) is injected at most other sites.

As shown on the block diagram, as a first activity crude, gas & water components are separated out. After separation of any gas & liquids, the produced sour gas is passed through a contactor or absorber tower in a one or two stage process where the sour gas typically comes in contact with a “acid gas removal units”. This is shown as “Sour Gas Processing Unit” in the block diagram.

After the acid gas is separated, it is compressed, dehydrated, pipelined and injected through a disposal well. These operations depend on the properties of the H_2S and CO_2 mixture, the two gases having similar phase equilibria . The critical points are $T=31.1^\circ C$ and $P=7,380$ kPa for CO_2 and $T=100.2^\circ C$ and $P=8,963$ kPa for H_2S . Both CO_2 and H_2S form hydrates at temperatures up to $10^\circ C$ for CO_2 and more than $30^\circ C$ for H_2S , even if free water is

not present. Thus it is desirable to operate above the hydrate-forming temperature. Hydrates are solid ice like particles and are dangerous for machinery and process. Maintaining temperatures above 35°C prevents compressor breakdown and plugging, as well as plugging of the pipeline and injection well. Acid gas obtained after the removal of H₂S and CO₂ from the sour gas is usually saturated with water vapor in the range of 2 to 6%. The solubility of water in both H₂S and CO₂, decreases as pressure increases up to 3-8 MPa, depending on temperature, after which it dramatically increases. The solubility minimum reflects the pressure at which the acid-gas mixture passes into the dense liquid phase, where the solubility of water increases substantially with increasing pressure due to the molecular attraction between these polar compounds. This property is used in naturally dewatering the acid gas by compressing the gas from about 100 kPa to around 8 to 10 MPa for injection, thus reducing the water content to less than 0.5 mole% to avoid pipe and well corrosion.

The compressors can be either electric motors or natural-gas fuelled engine driven. Most installations require only four stages of compression. Their speeds are automatically controlled to ensure that the system can respond rapidly and accurately to changes in acid gas volumes. Maximum compressor discharge injection pressures range from 2.8 MPa to 8.9 MPa. Generally, the compressed acid gas is injected in a pressure-temperature range where the liquid phase is stable, resulting in an appreciable head pressure being generated due to the height of column of this liquid in the well bore, thus lowering the required compressor discharge pressure. To avoid cavitations, the acid gas must not enter the two phase region during compression. While sour gas or sweet gas that is injected in cycling (natural gas storage) schemes requires dehydration. However, many acid gas disposal schemes do not need to dehydrate the acid gas. By the 4th stage in a cycle, compression at pressures between 3 and 5 MPa will tend to dewater the acid gas if there are no hydrocarbon impurities present. Further compressing the acid gas increases the solubility of water in the acid gas, such that residual excess water dissolves into the acid gas, and more than counteracts the decrease in solubility due to inter-stage cooling. In the majority of cases dehydration is supplied by the compression cycle and only in a few cases tri-ethylene glycol, refrigeration or a desiccant is used.

The acid gas is transported from the compressor to the wellhead via a pipeline. Usually, the pipeline will be as short as possible. The disposal well should be near the plant but offsite. The safety risk increases as the length of the pipeline increases. The design engineer will attempt to minimize the number of connections while still giving considerations for future "Tie Ins". Pipelines reflect the fact that most of the current acid gas disposal projects handle small rates, in that most of the lines have a diameter of 60 mm (2 inch nominal). The line lengths in many instances are short, reflecting the fact that operators have either drilled the disposal well near the plant, or are using a prior existing well adjacent to the plant. The design stress levels, and especially the actual operating stress levels, are low, again reflecting the low injection pressure levels. Most lines are made out of carbon steel, although many of

the short lines are made out of stainless steel. Emergency shutdown valves are installed at both ends of the disposal pipeline. The pipelines connect the plant compressors to the injection wells, and range in length from 100 m to 20 km, with diameters ranging from 48 to 168 mm and wall thickness from 3.2 to 11 mm. The bottom hole pressure needed for injection is provided by the pressure at the wellhead and the hydrostatic weight of the acid gas in the well, minus friction losses down hole and across perforations. The wellhead is equipped with a pressure control valve that regulates pressure. All disposal wells need to be equipped with downhole packers, to protect the casing strings. Casing depths range from 856 to 3,335 meters. Casing diameter ranges from 114 to 244 mm, while the tubing diameter ranges from 60 to 244 mm. Many wells are equipped with L-80 grade tubing, which is considerably stronger than would be required for the experienced injection pressure levels. To protect the tubing against the possibility of internal corrosion, several operators have elected to use internally coated tubing. If the gas is under saturated in water content, corrosion is minimal in any case. Subsurface safety valves have been installed in many tubing strings, as a safety measure in the unlikely case of backflow of acid gas from the formation. Many tubing strings are equipped with premium threads, to avoid potential tubing leaks. Overall, many precautions have been applied in well completions to ensure safe operations.

In the transport of the acid gas from compressor to well heads, it is expected that gas/liquid mixture will cool to ambient temperatures. The H_2S component has a tendency to form the hydrates when cold temperatures are encountered. To avoid hydrates formation, inhibitors such as methanol is used.

SUMMARY

Realizing that air pollution is getting more and more critical, it is very important that new emissions to atmosphere need to be tightly controlled. The rules and guidelines provided by the law of the country, on the subject need to be strictly adhered.

Acid Gas has devastating impacts on our eco-system. Acid deposition has a variety of effects, including damage to forests and soils, fish and other living things, materials, and human health. Acid rain also reduces how far and how clearly we can see through the air, an effect called visibility reduction. At places where other systems (Claus and other sulfur recovery methods) to reduce the acid gas are un-economical/unfeasible then AGI technique is an alternative to us.

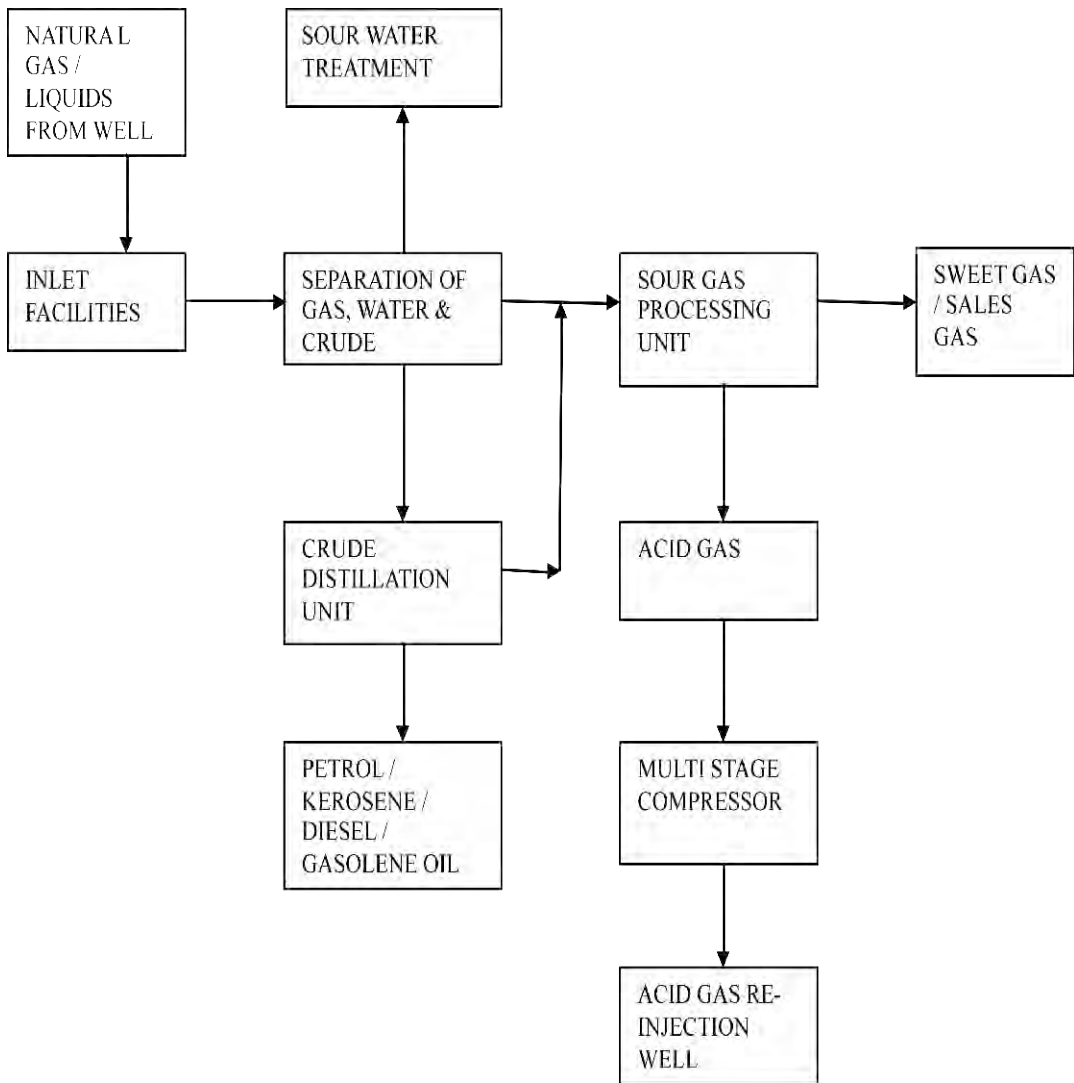
Acid gas injection has proven itself to be a successful, long term, safe method for dealing with previously unmanageable acid gas. In semi-populated areas and projects with larger acid gas, the AGI is a valid and highly encouraged way of dealing with nuisance acid gas. The acid gas techniques were discussed with reference to natural gas however, the techniques can be applied to other petrochemical industries & power plants.

The design of the AGI system including well depends upon several factors including geological studies. The AGI design need to consider hydrate prediction, water behavior, compression, piping, handling of acid gases, safety etc.

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ATYPICAL BLOCK DIAGRAM FOR ACID GAS INJECTION TECHNIQUES



The Common Property Resources of Thar Desert

Anil Kumar Chhangani, D.Sc.

Introduction

The forest land in Thar Desert is only 1.8% as against 5.6% of Common Property Resources. These CPR's are common pool of resources which support rural population and their needs for firewood, fodder, grain, water, herbal, gum, fencing and thatching, etc. Over 175 plant species were recorded from different CPR's which includes trees, shrubs, herbs and grasses. Faunal diversity includes 45 mammalian species, 41 reptiles species, 180 bird species and 80 fish species reported from in and around these CPR. Many of these floral and faunal species are listed in the Schedule I to IV of the Wildlife Protection Act 1972 and IUCN "red data book". This indicates that CPR's are focal points of the floral and faunal diversity richness and abundance which contribute more to regional biodiversity and support a large section of the society. The Thar Desert covers an area of about 0.32 million sq. km., which is nearly 12% of the total geographical area of India. It spreads over the four states of Rajasthan (62%), Gujarat (20%), Haryana and Punjab (9%), and in the west merges with the fertile plains of the Indus, in Pakistan. The Thar Desert of Rajasthan comprises 13 districts stretching from Ganganagar district in North to Sirohi in South and Jaisalmer in its West. The Thar Desert is essentially a sand Desert, most of whose area consists of dry undulating plains of hardened sand. The remaining region is largely a mass of loose sand, forming shifting sand dunes. The Desert environment is inhospitable for plants, wild animals and human populations. Yet, the Thar Desert is the most populated Desert in the world. Population density here is 84 persons per sq. km. In spite of such a precarious situation the people of Thar have learnt to live with droughts by involving such mechanism like collection, conservation and judicious use of rain water; crop lands converted for furthering ground cover to augment fodder production as '*Gauchars*' and lands with rich biodiversity dedicated to local deities and hero's as '*Orans*' and '*Agores*' to conserve germ-plasma for posterity. This is evidenced by species richness, genetic variation and biological diversity, which exist in Thar. There are over 900 species of plants found in Thar most of which are endemic to this Desert,

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while a few exotic species like *Prosopis juliflora* is predominant in different habitats. Of over 900 species, some 85 species of grasses are native to Thar Desert including 'Sewan' and 'Dhaman'. The common plant species are Khejari (*Prosopis cineraria*), Ker (*Capparis decidua*), Kumbhat (*Acacia Senegal*), Bare (*Zyziphus nummularia*), Rohida (*Tecomela undulata*), Jal (*Salvedora oleoides*), Fog (*Caligonum polygonoides*), Saven (*Lasirus scindicus*) and Thor (*Euphorbia granulate*), besides a variety of grasses. The *gaucher-oran-agor* trios are repositories of biological



(Plate 1)

View of CPR in the Thar Desert



(Plate 2) Blackbuck (*Antelope cervicapra*) heard in the CPR

like Caracal (*Caracal caracal*), Wolf (*Canis lupus*), Desert cat (*Felis sylvestris*), Desert fox (*Vulpes vulpes pusilla*), Blackbuck (*Antelope cervicapra*), Chinkara (*Gazella g. bennettii*), Nilgai, (*Boselaphus tragocamelus*), Wild Boar (*Sus scrofa*) and many birds and reptiles. The Indira Gandhi Nahar originates from Harike Barrage from where the fish species from Punjab have intruded into the Desert and thus majority of the fishes of the canal are of Sub-Himalayan origin. Along the canal several water logged areas were developed in and around the waste lands and other CPR's. These are now called as escape reservoirs, which have created new geomorphological conditions in the Thar Desert. These escape reservoirs are large enough to function as perennial water bodies, and supports substantial biomass of fish and great diversity of the other aquatic fauna. It is to be remembered that Rajasthan has traditionally been the holders of good livestock population since the rural economy largely depends on livestock which is next to agriculture. For example, the total livestock population of Rajasthan as per 1997 livestock census, comes to 5,46,27,756. This includes an estimated population of 1,21,41,402 cattle, 9770490 buffalo, 14584819 sheep, 16971078 goats, 669443 camels, 185604 donkeys, 304820 pigs and 24016 horses, which is about seven percent of India's total livestock population and the animal husbandry contributes 19% of the State GDP (as per Government of India, Planning Commission Report 2006). This livestock and variety of wild faunal population is largely sustained on the Common Property Resources (Plate 3).



Plate 3: Sheep heard drinking water at CPR

Keeping this in view listing of all plants and animals encountered in the different Common Property Resources of the study sites were attempted, new information gathered with the earlier records and presence confirmed.

The present observations of CPR's were carried out in the Great Indian Thar Desert of Rajasthan in the districts of Ganganagar, Hanumangarh Bikaner, Nagour, Churu, Sikar, Jhunjhunu, Jodhpur, Jaisalmer, Barmer, Jalore, Pali and parts of Sirahi. It is important to keep in mind that these districts in Rajasthan's Thar Desert have traditionally been regions of successful livestock rearing and that the rural agricultural economy includes a significant livestock component. Historically the State, despite its harsh climate, has supported this high cattle population by maintaining the availability of good pastures, at least until very recently. Common property resources including '*Gauchars*' (village pastures), '*Orans*' (village forests), '*Agores*' (catchment of village water bodies like Nades and Talabs) '*River bed*' (Stony, sandy ground over which dry rivers flow), etc. and such other community lands owned by the village. These common property resources are the main producers and maintain hotspots of biodiversity and support both livestock and wild animals of the area. The same areas have become favorable habitats for resident and migratory avian fauna where food, water and suitable nesting and breeding sites are available. The CPR's in the Thar Desert are very productive so far as their topography, phytogeography and biota are concerned.

Type of Common Property Resources

To sustain huge population of livestock especially cows and many wild herbivores the natural pastures and fodder species found in different Common Property Resources has played a major role in keeping the ecological balance. There are several such pastures in every district, which need evaluation for flora and fauna and their current capacity to support livestock and wildlife besides scope of intervention to augment their productivity. It is interesting to note that the forest land in Desert is only 1.8% as against 5.6% of Common Property Resources which suggest importance of these institutions for biodiversity. Every small and large village has its own village institutions, each village by and large, contained one or more of following important Common Property Resources:

1. **Gaucher:** Defined as gram Panchayat controlled grazing lands.
2. **Oran:** Defined as areas where tree cutting is banned by community consent and divine control, and where such restraint is actively observed.
3. **Agor:** Every small or large village has its own water source called *Nadi* or *Talabs* near by the village and store rain water for livestock and human consumption.

The Catchment of these Nadi and Talabs is known as *Agore*.

4. **Sand dunes:** Defined as natural sand masses, either stationery, or stabilized, or shifting. Usually with good moisture.
5. **River Bed:** Some of the important rivers like Luni, KanwarSen, Ghaggar, Jojhari, Sukari, Jawai and Meithri, through most of the rivers are seasonal and flows during rainy season only.
6. **Forest Enclosures:** Defined as land under the present control of the Forest Department, for plantation.
7. **Gravel Lands:** Defined as low productive areas with little soil cover and moisture.
8. **Wastelands:** Defined as areas with a mixture of characteristics and with low productivity.

Role of Common Property Resources

The role of *Gauchars* in maintaining Thar's economy was enormous till early fifties. From 1960 with the onset of intensive agriculture and tube well culture the decline of *Gauchars* set in. In the process some 400-year-old culture and tradition of *Gauchars* in the Desert started dyeing. A case of Jaisalmer district is unique. In Pali-Digga area of this district thousands of sq. km. of natural pasture of 'Sewan' *Lasiurus sindicus* grass is available which used to feed thousands of cows in drought as well as good rain years. Tharparkar, the best cow breed of this region survived because of natural Sewan pastures. It is now proven that the Sewan grass is perhaps the best fodder species. It contains 7-11% of protein with over 8 years of life after harvest. It was evidenced during the worst drought of 1986-87. Jaisalmer district supplied about 2 lack quintals of Sewan fodder harvested from Jaisalmer's natural Sewan pasture to 10 districts of Rajasthan. In absence of scientific data our information is based on 'bahis', oral stories, anecdotes, folktales and folklore, war tales, and biographies of warriors, local hero's and deities. It has been estimated that most *Orans* are about 150-500 years old while some are in existence for 700-800 years. It appears that *Orans* came into being concurrently with the founding of a village. Most of the *Orans* are dedicated to deities, local heros and martyrs. *Orans* in Desert thus have been named after about 100 such revered dignitaries like Bheruji, Hanumanji, Shivji, Ramdeoji, Papbuji, Gogaji, Vankalmate, Karnimate, Jogmaya, Chamunda and Mamaji ka *Oran*. In most *Orans* a temple of a deity or local hero or '*Than*' is present thus maintaining sanctity of the *Oran* till date. Unfortunately the quality and productivity of *Orans* have gone down considerably in the recent past yet their sanctity remains. An *Oran* is a repository of biological diversity of that area. It supports livestock of one to several

villages inhabited around besides housing one or more water bodies. Table 1 is showing some of the major *Orans* with in area of the Thar Desert of Rajasthan.

Table 1: Major *Orans* with area of the Thar Desert in Rajasthan

S. No.	Name of <i>Oran</i> (Tehsil)	Area in Bighas
1.	Dhok Vevetara Mata (Chohatan)	17947.00
2.	Unrod (Sheo)	10463.50
3.	Indroi Mataji (Barmer)	6684.02
4.	Girab (Sheo)	6650.10
5.	Kusip (Siwana)	4377.50
6.	Bothiya-Purohitaan (Barmer)	4165.30
7.	Chuli (Barmer)	2924.19
8.	Nai-Khadali (Guda-Malani)	1711.08
9.	Lakhotali (Barmer)	1537.08
10.	Ramaniya (Siwana)	1394.06
11.	Bhadariya ji (Pokhran)	42000
12.	Ramdeora (Pokaran)	35171
13.	Eta (Pokaran)	33124
14.	Janara (Pokaran)	13871

15.	Gomat (Pokaran)	11385
16.	Khelana (Pokaran)	8681.12
17.	Parewar (Jaisalmer)	7836.07
18.	Jemla (Pokaran)	7553.16
19.	Khetalai (Pokaran)	6551.12
20.	Bhensala (Pokaran)	5326.02
21.	Beeramdevra (Pokaran)	5216.08
22.	Nosar (Osian)	9394.1
23.	Bhiyansar (Phalodi)	6819.12
24.	Jakhan (Osian)	5980.15
25.	Barsingho-ka-Bara (Phalodi)	55315.19
26.	Tekara (Phalodi)	5468.8
27.	Jalora (Phalodi)	4625.16
28.	Punasar (Osian)	4048.5
29.	Dechu (Shergarh)	3562.4
30.	Palina (Phalodi)	3018.16
31.	Tapu (Osian)	2545.18
32.	Baori-Barsingha (Phalodi)	2541.19
33.	Kolu-Pabuji (Phalodi)	15800
34.	Veeratra (Choutan)	18000

Most of the *Orans* support 2 or more villages of the area, some even 5 or more while we have found a few supporting as many as 30 villages. There are 2-3 *Orans*, which support as many as 100 villages around which speaks of the potentiality of these *Orans* till today. Interestingly nobody is allowed to cut trees, remove its produce or deshape any part of *Oran* or use it for personal purposes. But, the produce of *Orans* can be used for community purposes. Even defecation and urination is prohibited in *Orans* and *Agores*. In spite of such strict unwritten code of conduct the *Orans* and *Agores* are facing variety of threats for their survival. Minor forest produce such as fallen fruits are collected by local inhabitants. Due to faith and sanctity, *Orans* are free from encroachment and indiscriminate exploitation, but *Agores* are facing serious threat of encroachment and unwanted developmental activities by the local Panchayat. There is no formal regulatory authority that imposes any type of legal control over the people of the region; *Orans* are an oasis in the Desert ecosystem that helps in maintaining the fragile ecosystem of the Indian Thar Desert. Traditional approaches of biodiversity conservation should be recognized by the policy-makers. These practices must be integrated for better management of biodiversity in consultation with the local community (Dagla et. al, 2007).

Conservation and management of CPR's

It is important that the availability of fodder species in different Common Property Resources which play their role quietly in supporting livestock, wildlife and human needs. These Common Property Resources needs to be studied to strengthen their productivity. Very little is written on legal and administrative status of these CPRs. In absence of legal and administrative protection without punitive provisions for those who encroach, mutilate, deshape or make use of CPR's for individual benefit, they are decaying fast. The *Agors* of water body are frequently tempered and interrupted for variety of physical works by local residents and State-agencies. Hundreds of cases from Tehshil to State Revenue Board are fought concerning CPR's protection and ownership but their legal status remains undefined and unassigned. In very simple term *Agors* are designated as revenue lands ownership of which lies with the State through Gram Panchayat which is supposed to monitor, guard and protect it. No data are available on its extent and total area lying under *Agors* in Thar. *Gauchar* is a revenue land, which finds place in State revenue records. It is designated as grazing land for livestock. This land is under the direct control of gram Panchayat, which cannot change or alter its character. However, District Collector (DM) can convert it in public interest for which DM has to provide equal land elsewhere in that village for

grazing purposes to be named as *Gaucher*. In Government land records *Orans* have not been given their due status, though traditionally it is a revenue land. These are referred to as sacred lands dedicated to deities but without any defined legal status. However, the whole village through village Panchayat works for its upkeep, protection and management. Traditionally it cannot be used for any other purpose or allotted to any one for any other purpose except to revere it as sacred village forest. An *Oran* often houses a temple or *THAAN* where people come for prayers and offerings. Since these CPR's serve some critical needs of poor and landless, ecological rehabilitation of the AGO's will serve a great social object and address the equity and gender issues. As *Agors*, *Gauchars* and *Orans* are interlinked and interdependent these cannot be handled in isolation. So a comprehensive approach is necessary for their conservation, management and sustainable use.

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SOCIAL BEHAVIOUR OF WHITE CRESTED KALIJ PHEASANT *LOPHURA LEUCOMELANOS HAMILTONII* (GRAY) IN GARHWAL HIMALAYA, INDIA.

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Abstract

Present paper deals with social behaviour of White crested kalij pheasant in Garhwal Himalaya, India studied during November 2007 to April 2009. A total of 1772 Kalij in 358 groups were recorded in 405 sightings. Overall individuals/sighting, group size and sex-ratio between male and female across the seasons were recorded 4.35, 5.10 and 1.34:1.00 respectively. Significant fluctuation was also observed in population and group size. Maximum value of population size and group size were recorded during monsoon and post-monsoon and winter season whereas minimum for the same were recorded during spring and summer season. Highest sex-ratio was registered during spring and monsoon and post-monsoon season while lowest for the same during summer and winter.

Key words: *White crested kalij, Social behaviour, Garhwal Himalaya.*

Introduction

Study of social behaviour of any wild animal species furnishes accurate information on the population size at particular time of the year or season for a wildlife manager or game biologist for successful management in a particular habitat, especially when the target animal faces threat to its survival. Pheasants are medium size, charismatic, brightly colored, ground nesting, non migratory, forest dwelling game birds, belonging to the Order '*Galliformes*' and Family '*Phasianidae*'. They have long been closely associated with social and religious status of people living in Asia and Europe. Their presence or absence in an area is indication of the healthy ecosystem. Total 51 species of pheasant have been reported so far in the world. Out of which 17 are found in India, and Garhwal Himalaya harbors 7 pheasant species viz., Red jungle fowl *Gallus gallus*, Indian pea fowl *Pavo cristatus*, Himalayan monal *Lophophorus impejanus*, Kalij pheasant *Lophura leucomelanos*, Koklass *Pucrasia macrolopha*, Cheer pheasant *Catreus wallichii* and Satyr tragopan

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Tragopan satyra (Sinha and Chandola, 2007). Only Kalij pheasant is sympatric to other pheasants.

Kalij pheasant is one of the twelve pheasants recognized under genera '*Lophura*'. Nine subspecies or races of Kalij pheasant are known to occur from Indus to Northeast Assam, southward to Burma and Western Thailand (Delacour, 1977). Due to global popularity of this sport bird it is now common in game farms of the United State of America in Michigan and Texas and its different races have been successfully released in Tennessee, Virginia, Oregon, Washington, British Columbia and Hawaii island (Bohl and Bump, 1970; Blank, 1981; Lewin, 1971). In India, only one subspecies the White crested kalij *L. l. hamiltonii* (Fig.1A) is the most widely distributed and common, found in small parties (up to 12) in Jammu and Kashmir, Punjab, Himachal, Uttarakhand and up to Nepal from 400 - 3600m altitude (Ali and Ripley, 1983; Singh and Singh, 1995). In last few years, over hunting, trapping, poaching and wide scale habitat destruction (Bisht *et al.*, 2002; Hilaluddin *et al.*, 2005b) due to bush fire, forest burning and fast developmental activities like extension of roads networks, hydro-electric power projects and electric lines (Kumar and Bisht, 2010) have caused overall decline of Kalij population among other wild animals. As a result, Kalij has now been listed as 'Lower risk' bird by IUCN in Red Data List and included in Schedule - IV of WPA, 1972 (Fuller and Garson, 2000; IUCN, 2006). Therefore, present study was undertaken to provide current information on social behavior (individuals/sighting, group size and sex-ratio) of Kalij pheasant on the basis of actual sighting at Nagdev Resserve Forest, District Pauri-Garhwal, Uttarakhand.

Materials and Methods

Study Area

The study was carried out at Nagdev Reserve Forest in District Pauri-Garhwal, Uttarakhand which lies between 30° 15' N & 78° 30' E and covers approximately 5.40 km² area on northeast facing slope behind Pauri town at 1700-1950m altitude (Fig.1B). General climate of the study area is moderate and receives average 136.65mm³ annual rainfalls and maximum and minimum temperatures fluctuate between 12.8° to 22.3° C and 6.4° to 18.5° C respectively. The area has mixed temperate forest comprised by *Pinus roxiburghii*, *Cedrus deodara*, and *Cupressus sps.* (trees), *Rubus*, *Berberis*, *Rosa*, *Rhus*, (shrub) and *Eupatorium* (exotic weed). A training center of paramilitary force - SSB (Sashtra Seema Bal) and a small hamlet with few human settlements is located near the study area. Two permanent water sources and dumping ground of the municipality waste fall within

the study area and are utilized by Kalij pheasants.

White crested kalij pheasant *L. l. hamiltonii* is a common non-migratory sport bird and popularly known as 'Kala murga' or 'Kukera' inhabiting all habitat types (subtropical dry deciduous forests to temperate coniferous forests in Garhwal Himalaya, Uttarakhand (Bisht *et al.*, 2002). A few resident populations of this bird were monitored for 7-15 days every month with the help of the binoculars from November 2007 to April 2009. By following the Fixed trails, Point count and Line transect methods (Javed and Kaul, 2002), data was collected on individuals/sighting, group size, male-female sex ratio, biotic pressure etc. Data was analyzed by statistical 't' test and one way 'ANOVA' (Fisher, 1963).

Result

Table - I represents detail of findings. During the study period (November 2007 to April 2009), a total of 1772 Kalij were recorded in 405 sightings. The overall 4.35 ± 0.95 Kalij were sighted in single sighting (range from 1.07 ± 0.17 to 7.36 ± 1.90). Low population size was noticed from March to June (2008) but significant increase was recorded by the month of July and attained maximum size in October (7.36 ± 1.90 individual/sighting; $P < 0.001$, June vs October). Therefore, a decline in population was observed. Kalij is a social bird that remains in group of 2 to 12 (Hume and Marshal, 1879; Singh and Singh, 1995). Total 358 groups of Kalij were observed with average group size 5.10 ± 1.25 throughout this study. The group size was recorded low from March (Fig.1C) to June followed by an increasing trend from July onwards (Fig.1D) and attained maximum size in October 8.75 ± 2.84 ($P < 0.02$, October vs. June. Overall 1.34:1.00 (range 1:1 to 2.18:1) sex ratio between male and female was found.

Seasonal records of both population size ($F_3, 14 = 6.77$, $P < 0.001$), and group size ($F_3, 14 = 5.55$, $P < 0.001$) also revealed variations (Table - II). During winter season (November to January), total 696 Kalij in 130 sightings was recorded with overall 5.33 ± 1.10 individuals/sighting and 6.26 ± 1.52 group size. In spring season (February to April), 484 individuals were noticed in 146 sightings with 3.23 ± 0.65 individual/sighting and 3.78 ± 0.68 average group size. During summer (May to July) season, 178 individuals were sighted in 64 sightings with 2.56 ± 0.77 individuals/sighting and (lowest) group size 2.96 ± 0.75 . In monsoon and post-monsoon (August to October) season, in 65 sightings, 414 individuals were recorded with 6.41 ± 1.44 individuals/sighting and (highest) group size 7.58 ± 2.08 . Maximum sex-ratio 1.36:1 was recorded in spring followed by monsoon and post-monsoon (1.3:101), winter (1.34:1), and summer season (1.33:1).

Discussion

Records on sightings of Kalij pheasant collected from Nov. 2007 to April 09 in Garhwal Himalaya, Uttarakhand, reveals seasonal variations. Both population and group size were found quite high during winter and post-monsoon season while decline was recorded in spring and summer season. Seasonal variations in population and group size could be due to the ultimate and proximate factors (Chandola-Saklani *et.al.*, 1987). Small population and group size during spring and breeding season could be due to reproductive behavior or illegal hunting or predation. In Kalij pheasant, breeding generally starts during March onward (Ali and Ripley, 1983) when pairing between adult male and female take place and pair bond is established. Thereafter, pairs get dispersed in habitat and territory formation occurs. Within territorial range, female prepares herself for laying eggs on her ground nest and becomes busy in incubating them. Consequently, sightings of Kalij become reduced during this period. During monsoon and post-monsoon and winter season, high population size and group size could be due to merging of small coveys with newly hatched juveniles.

Among proximate factors, rainfall associates with growth of vegetation-grass, leaves, flower, fruits seeds and insects and seasonal ground animals (leeches, slugs, snails, earthworms etc). Sub-adults after attaining maturity during post-monsoon as indicated by their sexual dimorphism start appearing in the large covey/flocks due to ample food availability as reported in other game birds like Cheer pheasant *Catreus wallichii* (Phulailatpan, 2005) Black partridge *Francolinus francolinus* (Shah *et al.*, 2002). During autumn and winter, Kalij in a typical family unit of 5-7 also appear on the edges of roads, trails, forest clearings and near human settlements because of waste garbage, cattle dung and stones and grits (containing undigested grains and insect larvae) (Hume & Marshal 1879, Bump & Bohl 1961, Bohl, 1971). Hume & Marshal (1879) and Singh & Singh (1995) reported that Kalij can be sighted in a group of 2 to 12 birds. Bisht & Dobriyal (2002) also reported 12 birds only in single site at 2400m altitude in Kedarnath Sanctuary, District Chamoli Garhwal. But in our study, maximum 9 individuals only were sighted in a group feeding on garbage near SSB colony in the month of October. Maximum 7.36 ± 1.90 individuals/sighting and 8.75 ± 2.84 group size in October suggests that overall population has been declining even in reserve forests.

Living in large groups benefits the birds to procure food easily and helps in minimizing a risk of predation with increasing number of individuals (Hill & Robetson, 1988). So, incidences of hunting, trapping and poaching and predation

come into existence with their social behaviour that results decline in population. On many occasions, leg hold trappers made by nylon, electric, and telephonic cable noose were recovered from trails used by Kalij during after emergence and before roosting, and carcasses and feathers of dead birds were found in study area. Hunters also locate the roosting birds on trees with help of torch, and then kill them by the gunshots. In the hills of Uttarakhand, many areas are still interior and people are not able to have daily basic life amenities like meat or chicken. Therefore, they rely on the wild meat mostly on Galliformes. In such areas, a house hold on average extracts 216 kg of wild meat annually, of which most of 5.2 % come from pheasants, and Kalij is only most hunted species (Hilaluddin *et al.*, 2005b) because of its common occurrence near human habitation. Beside all the above factors, bush fire and forest burning during summer season further reduce number of breeding pairs year after year. Some population loss takes place during spring and breeding season due to bush fire, forest burning and destruction and picking of eggs from their nests by local people to eat.

Suggestions

A) Awareness in the people about:

- Importance of pheasants/wildlife.
- Demerits of forests/bush fire
- Illegal activities as hunting, poaching, trapping, and egg steeling.

B) Preparation of scientific action plan under the guide lines of pheasant experts for hilly states.

C) Involvement of wildlife manager or game biologist and inviting suggestions from the people, research scholars, pheasant experts, college and university teachers etc. at the time of making of policies on various developmental works like widening of existing roads, construction of new road networks and hydro-electric power projects through diversity rich areas

In near future, this 'Lower risk' bird may also become extinct in Garhwal Himalaya, if a scientific action plan for conservation of pheasant with the help of experts is not prepared & implemented

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Table 1: Population, group size and sex ratio of Kalij pheasant *L. l. hamiltonii* at Nagdev Reserve Forest, District Pauri-Garhwal. (Figures in parenthesis are total number of groups recorded).

Month	Sighting	Total individuals	Pop. size (ind./sighting)	Average group size	Sex ratio (M : F)
November 2007	30	180 (27)	6.00±1.05	6.66±1.33	1.16:1
December	20	114 (16)	5.70±1.26	7.12±1.89	1.23:1
January 2008	13	76 (10)	5.84±1.64	7.60±2.52	1.9:1
February	24	131 (21)	5.45±1.07	6.23±1.38	1.18:1
March	34	107 (30)	3.14±0.52	3.56±0.48	1:1.06
April	26	57 (26)	2.03±0.42	2.85±0.35	1.03:1
May	27	46 (25)	1.70±1.24	1.84±0.21	1.19:1
June	13	14 (12)	1.07±0.17	1.16±1.65	1:1
July	24	118 (20)	4.91±0.90	5.90±0.41	1.8:1
August	21	121 (18)	5.76±1.21	6.72±1.69	1.81:1
September	25	153 (21)	6.12±1.22	7.28±1.73	1:1.04
October	19	140 (16)	7.36±1.90	8.75±2.84	1.23:1
November	22	120 (19)	5.45±1.11	6.31±1.50	1.12:1
December	24	130 (22)	5.41±1.03	5.90±1.25	1.20:1
January 2009	21	76 (19)	3.61±0.53	4.00±0.71	1.44:1
February	30	106 (27)	3.53±0.41	3.92±0.52	1.51:1
March	12	51 (12)	3.64±0.87	4.25±1.08	2.18:1
April	20	32 (17)	1.60±0.61	1.88±0.30	1.28:1
Average/total	405	1772 (358)	4.35±0.95	5.10±1.25	1.34:1.00

Individuals/sighting: $P < 0.001$ June vs. October, Average group size: $P < 0.02$, October vs. June

Table II: Seasonal records of population, group size and sex-ratio of Kalij pheasant *L. l. hamiltonii* at Nagdev Reserve Forest, District Pauri - Garhwal

Season	Sighting	Total individual s	Pop.size (ind./sighting)	Average group size	Sex ratio (M : F)
Winter (Nov. to Jan.)	130	696 (113)	5.33±1.10	6.26±1.52	1.34:1
Spring (Feb. to Apr.)	146	484 (133)	3.23±0.65	3.78±0.68	1.36:1.01
Summer (May to Jul)	64	178 (57)	2.56±0.77	2.96±0.75	1.33:1
Monsoon & post monsoon (Aug. to Oct.)	65	414 (55)	6.41±1.44	7.58±2.08	1.34:1.01
Significance level			F ₃ , 14=6.77, P<0.001,	F ₃ ,14=5.55, P<0.001.	

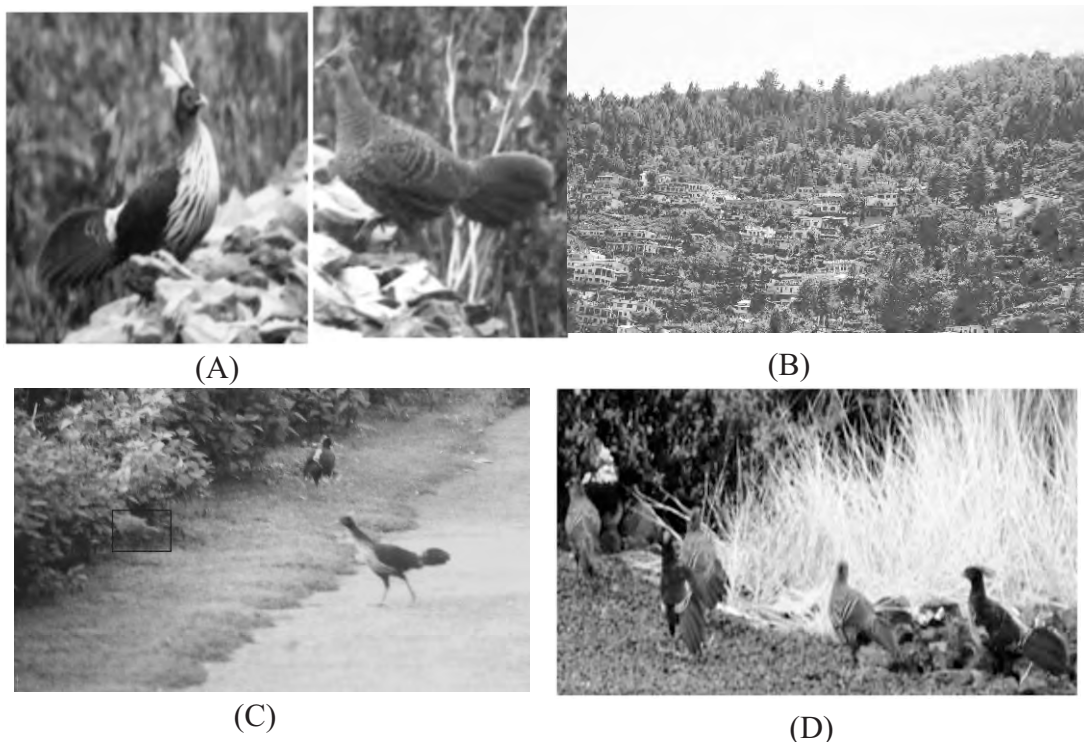


Fig. 1 : A Male White crested kalij pheasant *Lophura leucomelanos hamiltoni* with characteristics scarlet eye patch, white crest and black-shiny tail and female with dull brown plumage (A), Study site Nagdev Reserve Forest, adjacent to Pauri town (B), Small group of 3 Kalij (C) and Large group of 6 Kalij (D).

WHITE-BELLIED SEA EAGLE (*Haliaeetus leucogaster*) IN BHITARKANIKA NATIONAL PARK, ODISHA, INDIA.

*Nimain C. Palei, **Sandeep Mishra, ***H.K Sahu

INTRODUCTION

The White-bellied Sea-eagle (*Haliaeetus leucogaster*), also known as the White-bellied Fish-eagle or White-breasted Sea Eagle, is a large diurnal bird of prey in the family Accipitridae. It is closely related to other eagles, kites, hawks, harriers and vultures. It is resident from India through Southeast Asia to Australia on coasts and major waterways. It is a distinctive bird. The adult has white head, breast, under-wing coverts and tail. The upper parts are grey and the black under-wing flight feathers contrast with the white coverts. The tail is short and wedge-shaped as in all *Haliaeetus* species. It feeds mainly on sea snakes and fishes. It occupies the same localities for several years of succession and nests high up in casuarinas trees (*Casuarinas equisetifolia*) near the sea shore (Ali,1996). It is protected under Schedule-I of the Indian Wildlife (Protection) Act of 1972. White-bellied Sea-Eagle *Haliaeetus leucogaster* affects seacoast, tidal creeks and estuaries and is seen occasionally inland along tidal rivers and at fresh water lakes (Ali & Ripley 1978). Bhitarkanika mangrove ecosystem along the eastern coast of India harbours mangrove forests, rivers, creeks, estuaries, sand bars and mud flats hosting a small resident population of 10–15 White-bellied Sea-Eagles. (Gopi & Pandav, 2006).

The White-bellied Sea Eagle was first described by the German naturalist Johann Friedrich Gmelin in 1788. Its species name is derived from the Ancient Greek *leuko*- 'white' and *gaster* 'belly'. Its closest relative is the little-known Sanford's Sea-eagle of the Solomon Islands. These form a species pair, and as usual in sea eagle species pairs, as opposed to the dark-headed Sanford's, the White-bellied Sea-eagle has a white head. Talons, bill, and eyes are dark as in all Gondwanan sea eagles. This species pair has at every age at least some dark colouration in its tail, though this may not always be clearly visible in this species. Although they differ much in appearance and ecology, their ancestors diverged less than one million years ago, the "2%" value used is too low, as the author's remark, possibly by nearly an order of magnitude.

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White bellied Sea Eagle (*Haliaeetus leucogaster*,) is one of the few that breed here. White-bellied Sea Eagle is a monotypic species, with a world distribution stretching from India and Sri Lanka through Southeast Asia and the Philippines to Australia and Tasmania (Mayrand Cottrell, 1979; del Hoyo *et al.*, 1994).

The major habitats favored by White-bellied Sea Eagles include inshore seas, islands, coasts, estuaries and terrestrial wetlands (Robson, 2000). Adults are generally sedentary, while juveniles and immixtures are more prone to dispersing. White-bellied Sea Eagles are mostly seen singly or in pairs. Nests are built of sticks, and are 120-170 cm wide and 50-180 cm deep. They are used year after year (Del Hoyo *et al.*, 1994). Nests are built near water, on trees, and cliffs or – in the absence of predators – on the ground. Only rarely are nests built on artificial structures (Cluine, 1994).

Dharmakumarsinji & Khacher (1956). del Hoyo *et al.* (1994) report rabbits, fruit bats, seagulls (Laridae), cormorants (Phalacrocoracidae) and gannets (Sulidae) also in its diet. Murthy & Rao (1989) observed White-bellied Sea-Eagles feeding on dog-faced water snake *Cerberus rhynchops* and a large-sized wart snake *Achrochordus granulatus*. However, there have been no previous reports of White-bellied Sea-Eagle preying on a salt-water crocodile hatchling and this is probably the first observation of this kind.

MATERIALS AND METHODS

Study area: Bhitarkanika in Orissa is the deltaic region formed by the alluvial deposits of sacred rivers, Brahmani, Baitarani & Dhamara. The deltaic region is a unique habitat with mangrove vegetation on the side meandering creeks and tidal mudflat. The mangrove ecosystem is one of the largest in the India sub-continent and the floral diversity is the second highest after Papua New Guinea in the world. The diverse flora and fauna of Bhitarkanika make it a very complex ecosystem. Bhitarkanika is the land of mangrove, estuarine crocodiles & marine turtles. It is the unique habitat of mangrove forests creeks-crossed with numerous creeks and mud flats located in Kendrapara district of Orissa. It is one of the largest mangrove ecosystems of India. Bhitarkanika is the home to diverse flora & fauna of which some are endemic. There are several rivers like Brahmani, Baitarani, Dhamara & Mahanadi in the Sanctuary area. The wetland is represented by the protected areas namely Bhitarkanika Sanctuary, Bhitarkanika National Park and Gahirmatha Marine Sanctuary. It is the ideal habitat for the reptiles like estuarine crocodile, the largest Indian Lizard (water monitor lizard), King Cobra & Python. Important avifauna includes the kingfishers, storks, ibises, waders, and varieties of migratory ducks like Bar headed goose, Brahminy duck, Gadwall, Pintail, etc. It also harbors the Birds of Prey like, White Bellied Sea Eagle (*Haliaeetus leucogaster*). Bhitarkanika National Park has been constituted under the provision to the Sub-section 4 of section 35 of said act and comprises the core area of the Sanctuary. The area of N.P. is 145 Sq. km. The National Park is located between 86° 46' to 87° 03' east longitude and 20° 30' to 20° 48' north latitude.

Bhitarkanika is a wet land of international importance and attract a large number of

birds particularly during winter. Bhitarkanika has been declared a “Ramsar site”. Near Bhitarkanika, there is Gahirmatha Marine Sanctuary which extends along the coast from Nasi Island in the north east to the Telenga Muhan (Mahanadi mouth) in the south west. The Sanctuary extends 20 Km into the sea. It has been created to protect the endangered Olive ridley sea turtles, dolphins and other marine flora & fauna. Gahirmatha east which is part of the Sanctuary is used by lakhs of Olive ridley for mass nesting. Considering the ecological significance and diverse faunal & floral resource of Gahirmatha coastal water and the coast, Govt of Orissa has declared it as Gahirmatha (Marine) Wildlife Sanctuary in September 1997. It includes 1408 Sq. km of water body and 27 Km of land mass. Core area of this Marine Sanctuary is 725.50 Sq. Km & the buffer zone extends over an area of 709.50 Sq. km.

The coastal water of Gahirmatha enriched by detritus of mangroves of Bhitarkanika and Mahanadi delta is one of the richest fishery grounds of the world. It is the ideal habitat for white bellied sea eagle. Totally Bhitarkanika National Park and Gahirmatha Marine Sanctuary are unique habitat for the White Bellied Sea Eagle. The best sighting places are Barunei, Dubondhi, Ekakula, Dangamal, Habalikhathi, Satabhaya, and Talchua. The other places in Bhitarkanika block are Ganjeikhia nallah, Jalaghar, Mangalpur creek, Suajore, Munduli jore, Bad Suajare, Tinimuhan, Munduli, San Suajore, Khasabari, Matha area.

Method:

Data were collected from March 2007 to August 2007 for a period of six months. During the study period data were collected from different transects in the Bhitarkanika National Park for White bellied Sea Eagle and White-backed Vulture. The sighting were recorded using standard transect counting method. They were counted while walking along selected transect in each of the five selected locations (blocks) during morning 5.30 a.m. to 9.30 a.m. All transects were surveyed once in a week. These blocks were sampled using transect (foot path) method all together 5 Km were taken in each block. The transects are as follows: 1. Barunei to Chinchirimuhan, 2. Ekakula to Habalikhathi, 3. Satabhaya to Habalikhathi, 4. Dangamal to Khola, 5. Talchua to Kalibhanjadiha. To compare the diversity between all these locations, the Shannon Weiner index (H) was used (Kelvin *et al.*, 1990) the Shannon-Weiner formula (H) as given below:

$$H = - \sum_{i=1}^N P_i \log P_i$$

Where H = species diversity index

P_i = the proportion of individuals in the *i*th species

N = total number of species

I = species 1, 2, 3... N

RESULT AND DISCUSSION: White Bellied Sea Eagles (WBSE) were sighted in all the five blocks. Besides these blocks there were other locations in which the WBSE were

recorded are given with GPS locations in (Table -1).

During the study period a total of 17 nos. of WBSE were recorded from Bhitarkanika National Park. Out of which a maximum of 7 nos. of White Bellied Sea Eagle were found in Dangamal block & minimum 2 nos. of White Bellied Sea Eagle were found in Ekakula, Habalikhathi and Kalibhanjadiha blocks each. In Barunei block 4 nos. of White Bellied Sea Eagle were reported.

Month-wise sighting of WBSE were also recorded. A maximum of 17 sightings of White Bellied Sea eagle was reported in Ekakula-Habalikhathi transect in the 1st fortnight of April 2007. A minimum of 6 sightings of White Bellied Sea Eagle were recorded in various transects during June 2nd fortnight in Satabhaya- Habalikhathi and Dangamal-Khola transects and also in July 2nd fortnight in Talchua-Kalibhanjia transect. The highest no. of sighting (55) of WBSE was recorded in 1st fortnight of May '2007 and lowest sighting (40) in 1st fortnight of August'2008.

The species diversity index was calculated for each fortnight. The highest index value 0.39 was found in the 1st fortnight of April in Dangamal block. The minimum index value (0.21) was reported in all the blocks in different fortnights except Barunei block.

Ekakula Block – A maximum of 17 sighting of White Bellied Sea Eagle was found in 1st fortnight of April & minimum 7 nos. white-bellied sea eagle sighting in 2nd fortnight of May & August.

Satabhaya Block – A maximum of 13 nos. of White Bellied Sea Eagle was sighted in 2nd fortnight of April and August & minimum 7 nos. White Bellied Sea Eagle sighted was recorded in 1st fortnight of June & August.

Dangamal Block - A maximum 12 nos. of White Bellied Sea Eagle was sighted in the 1st fortnight of May & 2nd fortnight of July. Minimum 6 nos. of sighted in 2nd fortnight of June.

Kalibhanjadiha Block – A maximum of 12 nos of White Bellied Sea Eagle was sighted in 1st fortnight of March & May and 2nd fortnight of June. Minimum 6 nos. was sighted in 2nd fortnight of July.

Barunei Block: A maximum of 15 nos. of White Bellied Sea Eagle was sighted in 2nd fortnight of March and minimum 7 nos. in 1st fortnight of August'2008. In Barunei block four nos. of White Bellied Sea Eagle were sighted. In this block maximum disturbance caused by forest fire & vegetation destroyed due to poisoning of trees, fish farming & excessive disturbance in breeding from residential development & recreational activities.

During the survey in Bhitarkanika National Park, the White Bellied sea eagle was found to be highest in the Dangamal block because forest vegetation is more & habitat is suitable for the sea eagle. This block has suitable habitat with enough food and optimum temperature for the species and tall casuarina trees are also found in this block which helps the bird to perch.

Discussion

In Barunei block four nos. of White Bellied Sea Eagle were sighted. In this block the sighting

of the species is fifteen in the 1st fortnight of August highest diversity index ($H^1 = 0.38$) in 1st fortnight of August low at 1st fortnight of July. In Kalibhanjadiha block maximum diversity ($H^1 = 0.33$) in 1st fortnight of August & low at ($H^1 = 0.21$) 2nd fortnight of May & 1st fortnight July. In this block there is maximum disturbance caused by forest fire & low vegetation, During the survey in Bhitarkanika National Park, the White Bellied Sea Eagle was found to be highest in the Dangamal block because forests vegetation is more & the habitat is suitable for the sea eagle. In this block maximum 7 nos. of White Bellied Sea Eagle were found. The sighting was 12 in the 1st fortnight of April which is the highest number of sighting of the species in that block. It has also highest species diversity index ($H^1 = 0.39$) for this period, i.e., 1st fortnight of April. Minimum diversity index ($H = 0.21$) was observed in the 2nd fortnight of August and 2nd fortnight of May. This block has suitable habitat with food and temperature for the species and tall Casuarina plant species are also found in this block which helps the bird to perch.

During the study period of six months & survey in five blocks a total of 17 nos. White-bellied Sea Eagle were found in different blocks. The study shows that a maximum of 7 nos. of White-bellied Sea Eagle were found in Dangamal block, 2 nos. In Ekakula & Habalikhathi & Kalibhanjadiha block, 4 nos. in Barunei block.

Figure-1, Sighting of White bellied sea eagle in Bhitarkanika National Park

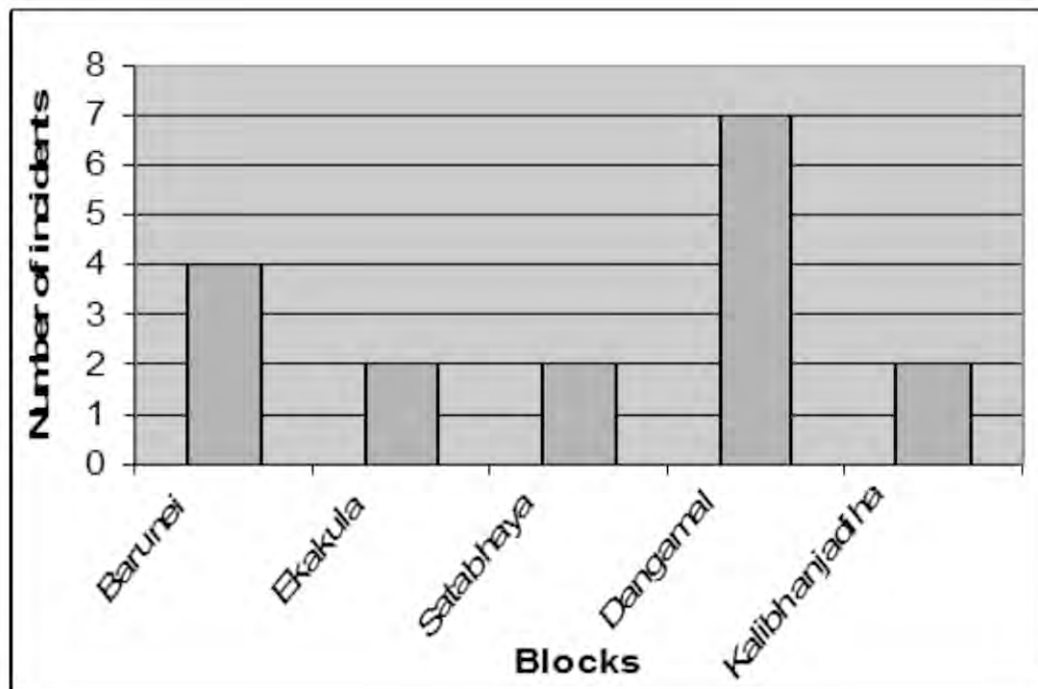


Table -2 Sighting of White bellied Sea Eagle in Bhitarkanika National Park.

Place Sighting	Latitude	Longitude
Dangamal	N - 20 ⁰ 43' 21	E - 086 ⁰ 51' 08.1"
Jalaghar	N -20 ⁰ 43' 57.6"	E - 086 ⁰ 51' 49.4"
Ganjeikhia nal	N - 20 ⁰ 43' 47.8"	E - 086 ⁰ 50' 19.5"
Sankhatua	N - 20 ⁰ 44' 32.7"	E - 086 ⁰ 54' 03.8"
Manasi Munda	N - 20 ⁰ 40' 49.1"	E - 086 ⁰ 52' 42.6"
Madhursalam Muhan	N - 20 ⁰ 44' 09.3"	E - 086 ⁰ 52' 34.5"
Suajare	N - 20 ⁰ 42' 47.9"	E - 086 ⁰ 52' 40.5"
Baunsajodi	N -20 ⁰ 42' 20.1"	E -086 ⁰ 52' 26.6"
San Suajore	N -20 ⁰ 42' 02.9"	E -086 ⁰ 52' 05.6"
Bad Suajore	N -20 ⁰ 41' 57.2"	E -086 ⁰ 51' 29.1"
Chhatuaghana	N -20 ⁰ 41' 54.2"	E -086 ⁰ 51' 13.0"
Munduli	N -20 ⁰ 42' 05.7"	E -086 ⁰ 51' 52.9"
Suajore Mahari	N -20 ⁰ 42' 46.9"	E -086 ⁰ 52' 52.0"
Khasabari	N -20 ⁰ 43' 10.3"	E -086 ⁰ 52' 03.4"
Matha aria	N -20 ⁰ 42' 44.1"	E -086 ⁰ 51' 42.1"
Kunjaban	N -20 ⁰ 42' 42.7"	E -086 ⁰ 51' 27.1"
Bali aria	N -20 ⁰ 42' 45.3"	E -086 ⁰ 51' 46.8"
Thakuranipadma Pokhari	N -20 ⁰ 42' 39.2"	E -086 ⁰ 52' 63.1"
Pator Soni	N -20 ⁰ 44' 02"	E -086 ⁰ 52' 11.0"
Ekakula	N -20 ⁰ 42' 15.6"	E -087 ⁰ 02' 03.8"
Habalikhati	N -20 ⁰ 40' 18.1 "	E -086 ⁰ 59' 32.7"
Satabhaja	N -20 ⁰ 38' 53.3"	E -086 ⁰ 56' 56.2"
Rajeswari Nagar	N -20 ⁰ 45' 30.9"	E -086 ⁰ 85' 36.3"
Talchua Ghat	N -20 ⁰ 45' 57.2"	E -086 ⁰ 58' 30.3"
Isharpur Khola	N -20 ⁰ 41' 43.0"	E -086 ⁰ 50' 11.2"
Bagagahan	N -20 ⁰ 42' 10.4"	E -086 ⁰ 52' 23.4"

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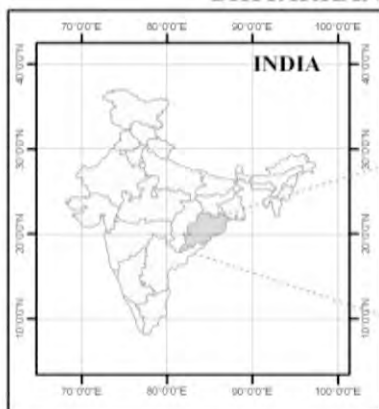
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LOCATION MAP **BHITARKANIKA NATIONAL PARK**





BREEDING IN CAPTIVITY

Dr. S.P. SINGH and Dr. M.K. PUROHIT

Captive breeding is a process of breeding animals in human controlled environment with restricted settings, such as wildlife reserves, zoos and other conservation facilities; sometimes the process is construed to include release of individual organisms to the wild, when there is sufficient natural habitat to support new individuals or when the threat to the species in the wild is lessened. Captive breeding programs facilitate biodiversity and species fitness.

History

Captive breeding has been used with success for some species for some time, with probably the oldest known instances of captive breeding being attributed to menageries of European and Asian rulers, a case in point being the Pere David's Deer. This species was successfully saved through captive breeding programs after almost being hunted to extinction in China. The idea was popularized among modern conservationists independently by Peter Scott and Gerald Durrell in 1950s and 1960s, founders of Wildfowl and Wetlands Trust and Jersey Zoo, who demonstrated success with a wide variety of life forms in the 1970s ranging from birds (e.g. Pink Pigeon), mammals (e.g. Pygmy Hog), reptiles (e.g. Round Island Boa) and amphibians (e.g. Prison arrow frogs). Their ideas were independently validated by the success of Operation Oryx (under the auspices of Fauna and Flora Preservation Society), which captive bred the Arabian oryx starting in 1963 for eventual reintroduction to the wild. The Przewalski's horse has recently been re-introduced to the wild in [Mongolia], its native habitat.

Coordination

The breeding of endangered species is coordinated by cooperative breeding programmes containing international studbooks and coordinators, who evaluate the roles of individual animals and institutions from global or regional perspective. There are regional programmes for the conservation of endangered species:

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- * Americas: Species Survival Plan(SSP) Association of Zoos and Aquariums(AZA), Canadian Association of Zoos And Aquariums (CAZA)
- * Europe: European Endangered Species Programme (EEP) European Association of Zoos and Aquaria (EAZA)
- * Australia: Australian Species Management Program (ASMP), ZOO and Aquarium Association ZAA)
- * Africa: African Presevation Program (APP) African Association of Zoological Gardens and Aquaria (AAZA)
- *
Japan: Conservation activities of South Asian Zoo Association for Regional Cooperation (SAZARC)
- * South East Asia: Conservation activities of South East Asian Zoos Association (SEAZA)
- Asia: Conservation activities of South East Asian Zoos Association (SEAZA)

Challenges

Captive breeding techniques are usually difficult to implement for highly mobile species like some migratory birds(e.g. cranes) and fishes (e.g. Hilsa). Species like large cetaceans (whales, dolphins, etc.) may also have some difficulties as it would be hard to meet their biological requirements in captivity, especially the vast amount of space required to keep large populations.

Genetics

If the captive breeding population is too small, inbreeding may occur due to the reduced gene pool, which lead to the population lacking immunity to disease and other problems. Over a sufficient number of generations, inbred population can regain “normal” genetic diversity.

For example, since the 1970s the Matschie’s Tree-kangaroo, an endangered species, has been bred in captivity. The Tree-Kangaroo Species Survival Plan (TKSSP) was established in 1992 to help with the management of Association of Zoos and Aquariums (AZA). The mean kinship strategy (MK) is used by TKSSP to make annual breeding recommendations to preserve genetic diversity in small populations. This is done to retain their adaptive potential and avoid the negative consequences of inbreeding. Comparison of the genetic diversity of the captive breeding program is

retaining the populations is done to evaluate how captive breeding program is retaining the population's genetic diversity over time. In a study done by McGreezy et al. (2010), 'AZA Matschie tree kangroos.' This difference with allele frequencies shows the changes that can happen over time, like genetic drift and mutation, when a species is taken out of its natural habitat.

Behaviour changes

Impacts of captive breeding include behavioural problems in released animals, which are not being able to hunt or manage for food leading to starvation. This could occur because when in captivity young animals miss critical learning periods. Released animals often do not avoid predators and are not able to find ample shelter for themselves and may die as a result.

Golden Lion Tamarin mothers often die in the wild before having offspring because they do not have the climbing and foraging skills they need to survive. This results in populations continuing to decline despite reintroduction because the species does not produce viable offspring. Training can improve anti-predator skills, but the effectiveness of such interventions is influenced by a number of constraints. Domestication is another challenge that captive breeding faces. In a study done by Belyaev (*1979) silver foxes were bred in captivity over several decades and many generations to display behavioural and physiological characteristics of a domesticated dog. The study found that after several generations of breeding the domesticated silver foxes picked up behavioural traits seen in domesticated dogs, such as wagging their tails, and licking the hands and faces of humans. They also showed physiological changes such as drooping ears, erect tails and two breeding periods per year. All of these characteristics are not present in wild silver foxes. The experimenters also mentioned that the domesticated foxes "eagerly seek human contact", which could be detrimental as they are hunted for their fur and are viewed as pests by poultry farmers.

Loss of habitat

Another challenge with captive breeding is the habitat loss that occurs while they are in captivity being bred (though it is occurring even before they are captured). This may make release of the species nonviable if there is no habitat left to support larger

populations.

As climate change increases and more invasive species are introduced, more and more species become threatened with extinction. Just from a decrease in population size, reductions in genetic diversity occurs which leads to a decrease in the ability of populations to adapt to the changing environment. In this context, loss of genetic polymorphism, which is a difference in DNA sequence among individuals, groups or populations, is related to extinction risk. Conservation programs can now obtain measurements of genetic diversity at functionally important genes due to advances in technology.

Success

In 1971 the Wild Cheetah and Wildlife Centre was established. Between 1975 and 2005, 242 litters were born with a total of 785 cubs. IN a study done by Bertschinger, H. J., Meltzer, D.J.A., Van Dyk, A. (2008), the survival rate of cubs was examined. “Mean cub survival from 1 to 12 months and greater than 12 months of age was 71.3 and 66.2% respectively.” This study shows that cheetahs can be bred successfully and that their endangerment can be decreased through these breeding programs. It also indicated that failure in other breeding habitats may be due to “Poor” sperm morphology.

Recently, the number of wild Tasmanian devils is declining from transmissible devil Facial Tumor Disease. A captive insurance population program has started, but the captive breeding rates at the moment are lower than they need to be. A study done by keeley, T.J., Fanson, B.G., Masters, K., and McGreevy, P.D. (2012), had a goal to “increase our understanding of the estrous cycle of the devil and elucidate potential causes of failed male-female pairings.” The temporal patterns of fecal progesterone and corticosterone metabolite concentrations were examined. The majority of unsuccessful females were captive-born, suggesting that if the species’ survival depended solely on captive breeding, the population would probably disappear.

In 2010, the Oregon Zoo found that Columbian Basin pygmy pairings based on familiarity and preferences resulted in a significant increase in breeding success.

There have also been recent advances in captive breeding programs with the use of induced pluripotent stem cell (iPSC) technology. This technology has been

tested on several endangered species. Scientists hope the stem cells could be used to be converted into germ cells in captive breeding programs to help diversify the gene pools of threatened species. Healthy mice have been born with this technology. It is suggested that induced pluripotent stem cells may one day be used in producing therapeutic solutions for captive animals suffering from diseases and increasing the size of endangered animal populations.

Biodiversity and Conservation in India

***Dr. Rakhi Upadhyay**

The biodiversity of a region is a valuable 'natural resource' which forms a part of every ecosystem. Man is a part of these ecosystems and is dependent on their integrity. Diversity in wild species forms the 'gene pool' from which our crops and domestic animals have been developed over thousands of years. Today the variety of nature bounty is being further harnessed through breeding programmes for crops and domestic animals or through biotechnology, by manipulating genes for developing better types of medicines and industrial products.

I. Classification of Biodiversity

Biodiversity deals with the variety of living organisms found in the biosphere. This variability can be observed at three levels:

(1) Genetic diversity - This is the variability among individuals of a species e.g., each human being differs widely from all others. This diversity is due to the large number of combinations possible in our genes that give us specific characteristics. If the number of breeding individuals is reduced in-breeding occurs. Eventually it can lead to the extinction of the species.

(2) Species diversity – It is known as the common level of diversity. This diversity of species is seen both in various natural systems, and in agricultural systems. Natural tropical forests have much greater species diversity than most other regions. Modern intensive agricultural systems have a relatively lower diversity than traditional agro pastoral farming systems where multiple crops were used. Intensive agriculture grows single crops whereas in traditional farming the farmer used to plant many different types of crops. Though intensive agriculture provides rapid economic returns, a disease can destroy the whole

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crop. In a multicrop system, if one crop is destroyed the other successful crops help the farmer to make ends meet. A natural forest has higher species diversity than a timber plantation, which is usually a mono-culture. In the natural system there are a large number of non-wood products that people depend on such as fruit, fuel wood, fodder, fibre, gum, resin and medicines. Timber plantations do not provide such goods for focal consumption.

(3) Ecosystem diversity – In which the diversity occurs between the biological communities, who live in different types of ecosystem. Each area has a variety of different ecosystems, have their own complement of distinctive interlink species. Each of them varies functionally and structurally from other systems. The ecosystem in an area is referred to as 'natural' when it is relatively undisturbed by human activities or 'modified' when it is changed to other types of uses. Natural ecosystems are forests grasslands, deserts and aquatic systems, either fresh water or salt water. These are wilderness areas with their own wild plants and animals which are of great economic value. If they are overused or misused their productivity eventually decreases. The ecosystem is then said to be degraded.

II. Value of Biodiversity

The world is inhabited by myriads of life forms, animal and plants. These life forms are of great diversity, living in diverse habitats and possessing diverse qualities, which in themselves make very interesting studies. Moreover, these life forms are vital to human survival as they provide food and materials for shelter, clothing, tools and medicine.

Daily requirements of human beings are fulfilled by biodiversity resources. Biodiversity contains a wide range of animal and plant species and used for several purposes like manufacturing food, cosmetic products and pharmaceutical. Different types of animals and plants have economical value. These are -

(i) Food- There are large number of products which are consumed by population. Parts of wild plants like leaves, roots, tubers, mushrooms, variety of

fruits, nuts, coffee, etc. are highly consumed. Wheat, maize and rice gives about 60% calories, 55% protein comes from plants into the humans.

(ii) Medicine - Medicine plays a crucial role in the medication. Several types of medicines extracted from higher plants. There are a wide range of wild species which gives us medicinal are benefits. Medicinal plants are important for Ayurveda and allopathic treatment. Micro organisms provide life saving drugs like penicillin, antibiotics atropine, bromelation, cocaine, quinine, morphine, disitixin, menthol, papair, tarot etc.

(iii) Social Value – Loss in diversity has many unfavorable implications related to ecosystem function such as energy flow and biogeochemical cycles. These will directly influence the social life of the country. Human activities are critical to the relationship between biological diversity and ecological processes. The current problems of air pollution and global climate change have clearly emphasized the need to understand the biodiversity response to these anthropogenic stress factors. Living things exist with specific ecological processes, and an unfavorable alteration in any of these has serious implications for the existence of each other. The values placed on biodiversity are strongly linked to the human influenced on it and their underlying social and economic driving forces.

(iv) Ethical value - The ethics of biodiversity loss is now a major consideration for saving biodiversity. This is particularly, so because such loss is forever and there is no way to recreate lost biodiversity. A few things stand out very clearly:

1. Realism demands that in the area of biodiversity there will always be tremendous interdependence between technology poor and technology rich countries. With the global climate change on the horizon, there are likely to be serious challenges, candidate genes will have to be identified to evolve new cultivars resistant/tolerant to such changes. Such cooperation between North and South must increase if human race has to succeed. No nation can be self-sufficient in biodiversity. There would always be newer demands.
2. Realistic national policy on conservation and utilization of biodiversity have to be evolved by a National Biodiversity Conservation Board in the best interest of each country.
3. Equally important is to support and build biotech capability in the

South by biotech-rich North. This would be to the mutual benefit of all countries.

4. Bridges have to be built between scientific and technical groups working in the area of conservation and utilization of biodiversity and the local communities and women's group.
- (v) Aesthetic value – Aesthetic is a branch of philosophy concerned with the essence and perception of beauty and ugliness. Biodiversity has aesthetic value. Efforts are being made to develop attraction for animals and plants by rearing them in zoos & gardens. Wild life is important from the viewpoint of its aesthetic and recreational value for man. Recreation and enjoyment are essential to man's health. Aesthetic values such as the taste of wild flowers compel us to preserve them. A world without melodious birds graceful and thick forest is poor. Thousands of plants are being conserved in gardens. Gardening is a science and art of growing fruits, vegetables, flowers, shrubs and trees on public places. Gardens are the means of biodiversity conservation and are of aesthetic value. Wild animals are also kept in zoological gardens.
- (vi) Option value – These are unknown values and need to be explored. These industries are directly related to micro-organisms, genes, molecule etc. The pharmaceutical field is more interested in wild species.

III. Biodiversity at Global, National and local levels

(i) Global level

It is estimated that there exists 5.30 million species of living forms on our earth and of these, only 1.5 million have been identified and include 3, 00,000 species of green plants and fungi, 8,00,000 species of insects, 40,000 species of vertebrate and the number of insects alone may be as high as 10 million, but many believe it to be around 5 million.

Bacteria – 3600, Blue Green Algae – 1700, Fungi – 46,893, Bryophytes – 17000, Gymnosperms 75, Angiosperms 25000 etc.

The tropical forests are regarded as the riches in biodiversity. According to the opinion of the scientists more than half of the species on the earth live in

moist tropical forests, which is only 7% of the total land surface. Insects (80%) and Primates (90%) make up most of the species.

The species diversity in tropics is high as:

- (1) In tropics the conditions for evolution were optimum and for extinction fewer.
- (2) In tropics, species diversity was conserved over geological time. Due to low rates of extinction, prevailing there; and
- (3) Biological diversity is the result of interaction between climate, organisms, topography, parent soil materials, time and heredity.
- (4) However, these explanations need experimental observations and confirmation.

(ii) National Level

India has large land area of 3,287,263 sq. km. The tropical the tropical & waters of the Indian Ocean with the Bay of Bengal to the South East and the Arabian Sea to the South West.

(iii) Local Levels

This level of biodiversity is characterized by grouping species. '**Alpha diversity**', where number of species found in a small homogenous area. '**Beta diversity**' where changes occur between species composition across different habitats. '**Gamma diversity**', means rate of change across large geographic areas. '**Point diversity**', as the number of species at a single point in a given area.

IV. Endangered and Endemic species of India. Endangered species are those which have a high likelihood of “**going extinct in the near future**”. Several plants and animal species are in immediate danger of extinction. The following degrees of endangerment have been defined. Threatened species are abundant but are declining in total numbers. Rare species exist in relatively low numbers over their ranges but are not necessarily in immediate danger of extinction.

Following animals have been declared endangered and have been declared protected species by the Government of India.

Endangered Fauna & Flora

Some of the underground Faunas 1. Crocodile, 2. Musk deer, 3. Snow leopard, 4. Asiatic Lion, 5. Indian rhinoceros, 6. Kashmir stag, 7. Tiger, 8. Indian Gharial, 9. Slender loris, 10. Black Buck, 11. Pigmy hog, 12. Leopard cat, 13. Elephant

In India, nearly 450 plant species have been identified as endangered, threatened or rare. A list of some such species in different parts of the country is given below (this may not be a complete list).

1. *Arachnanthe cathcartii* (Orchidaceae), 2. *Aphyllorchis montana* (Orchidaceae), 3. *Anoectolchilus sikkimensis* (Orchidaceae), 4. *Anacolsa ilicoides* (Oleaceae), 5. *Aglaia pervirens* (Meliaceae), 6. *Aconitum deinorrhizum* (Ranunculaceae), 7. *Astragalus strobiliferus* (Papilionaceae), 8. *Atropa acuminata* (Solcanaceae), 9. *Brainae insignis* (Blechnaceae), 10. *Balanophora dioica* (Balanophoraceae), 11. *Catamixis baccharoides* (Asteraceae), 12. *Colchicum luteum* (Liliaceae), 13. *Gentiana kurroo* (Gentianaceae), 14. *Lespedeza elegans* (Papilionaveae), 15. *Nardostachys grandiflora* (Valeriananceae), 16. *Ormosia glauca* (Papilionaceae), 17. *Rheum nobile* (Polygonaceae), 18. *Rhus hookeri* (Anacardiaceae), 19. *Tetracentron sinense var himalense* (Tetracentraceae), 20. *Vanilla pilifera* (Orchidanceae), 21. *Commiphora wightii* (Burseraceae), 22. *Rosa involucrate* (Rosaceae), 23. *Aldrovanda vesicnlosa* (Droseraceae), 24. *Anemia tomentosa* (Schizaeaceae), 25. *Lilium neilgherrense* (Liliaceae), 26. *Pterocarpus santalinus* (Papilionaceae), 27. *Dipterocarpus kerrii* (Dipterocarpaceae), 28. *Myristica andamanica* (Ophioglossaceae), 29. *Podocarpus neriifolius* (Podocarpaceae), 30. *Uvaria nicobarica* (Annonaceae)

V. BIODIVERSITY CONSERVATION: 'Ex-Situ' and 'In-Situ' conservation

Population explosion and unmanaged developmental activates have resulted in loss of global biodiversity. Both natural and man-made factors are responsible for the distribution of species and causing them to become rare or even extinct. There are several National Parks, Sanctuaries, Biosphere Reserves, Gene Banks etc. for conservation of biodiversity. To conserve the biodiversity, time bound action plan should be checked by State Govt. for quicki emplementation both by Ex-Situ and In-Situ methods.. In this way

maintaining of species and ecosystems and a vital need for survival of human race. Action plan have been made to rare biodiversity both by existed and in-situ conservation.

I. In-Situ Conservation

In-Situ Conservation means preservation of species in its natural ecosystem. Different areas which are managed for in-situ conservation are :

(a) National Parks and Sanctuaries- The strict prohibition & management of wild animals & their habitat in protected areas helps in-situ conservation of all flora and fauna found there. Alogwith legal protection offered by WLP Act 1972 strict enforcement is also neaded. There are about 500 sanctuaries and 70 national parks set up in India. Some of the important National Parks and Sanctuaries of India are :

- 1) **Andhra Pradesh**- Kewal, Pocharan, Pakhal, Meelapattu.
- 2) **Arunachal Pradesh**- Namdapha
- 3) **Assam**- Kaziranga, Manas
- 4) **Bihar**- Hazaribagh, Betla, Balmiki
- 5) **Goa**- Mollen
- 6) **Gujrat**- Gir, Velavador, Wild ass, Neel Sarovar
- 7) **Haryana** – Sultanpur Lake.
- 8) **Himachal Pradesh**- Simbalwarda, Great Himalayaner pin valley NP
- 9) **Jammu & Kashmir**- Dachigan, Kistwad NP, Changthang
- 10) **Karanataka**- Bandipur, Nagarhole,
- 11) **Kerala**- Perriyar, Weynard,
- 12) **Madhya Pradesh**- Kanha, Shipuri, Bandhavgarh, Panna, Pench
- 13) **Maharashra**- Tadoba, Pench, Melghat
- 14) **Manipur** - Keibul Lanjao
- 15) **Meghalaya**- Balpakran
- 16) **Mizorum**- Dumpa
- 17) **Nagaland**- Intangki
- 18) **Orissa**- Simlipal, Sat Kosia, Chilka lake
- 19) **Punjab**- Abohar
- 20) **Rajasthan**- Ranthambore, Ghana, Sariska

- 21) **Sikkim**-Kanchenjunga
- 22) **Tamil Nadu**- Guindy, Mudnrialai, Annamalai
- 23) **U.P**- Dudwa, Chambal, Ranipur
- 24) **West Bengal**- S Sunderban.
- 25) **Uttarakhand** – Corbett, Rajaji, Nandadevi, Valley of Flowers etc.
- 26) **Chhatisgarh**- Indrawati
- 27) **Jharkhand**- Hazaribagh

(b) Special Projects –

First Tiger Reserve come in existence in 1973 when the first ever conservation project was launched in Corbett National Park, Uttarakhand. The aim was to maintain a viable population of tigers & maintain their habitat. Conservation of tigers ensures conservation of its habitat with diverse flora & fauna. A total of 41 tiger reserves have so far been created in India. The scientific estimation of tigers, co-predators & their prey was first done in 2005 as all India basis & it was once again repeated in 2011. the estimated no of adult tigers in India is about 1700 tigers.

(c) Biosphere Reserves- A biosphere reserve contains domestic animals, wild animals, cultivated plants etc. A biosphere reserve is formed for multiple land us. It has different type of zones like – Restoration zone, Manipulation Zone, Buffer zone, Core zone.

A Biosphere Reserves Programme was launched by UNESCO in 1971 under its “Man and the **Biosphere Programme (MAB)**.”

The object of this programme are given below-

- 1) To provide a long term in-situ conservation of genetic diversity.
- 2) To promote and facilitate basic and applied research and monitoring.
- 3) To promote international cooperation.
- 4) To promote appropriate sustainable management of the living resource.
- 5) To provide opportunities for education and training.
- 6) To conserve representative samples of various ecosystems.
- 7) To disseminate the experience so as to promote sustainable development elsewhere.

(2) Ex-Situ Conservation

“It is known as “off site preservation”.

Or

“Conservation of species in suitable locations outside their natural habitat.” species require protection because its survival in wild may no longer be possible. Animal preservation include aquaria, game farm, zoos while plants are maintained in botanical gardens and in seed banks.

- (a) **Botanical Gardens-** The Royal Botanical Gardens of England consist of 25,000 species of plants. IUCN considers 2,700 of these species endangered or rare. Eight Botanical gardens occur in India. **Plant Resources Centre at Bhubneshwar** is the worlds longest botanical garden. The main importance of Botanical gardens is plants are available for research and horticulture. Recently NBPGR (National Bureau of Plant Genetic Resources) a special garden has been established in New Delhi.
- (b) **Seed Banks-** These are most important measure for long term storage of seeds. Gene banks reserve stocks of both seeds and vegetative plant parts. Seed shows genetic variability, so its storage ensures conservation of genetic diversity.
- (c) **Zoological Parks.** Zoos or zoological parks play a vital role in conservation of biodiversity. They give support for re-introduction of endangered species.
- (d) **Aquaria-** The world conservation union develops a breeding programme for endangered fish species. Aquaria give the captive propagation of threatened fresh water species.
- (e) **Tissue Culture Technique-** It is necessary for conserving “animal cells, ovarian, embryonic tissues etc.”

VI. ECOLOGICAL SIGNIFICANCE

Wild life animals play a significant role in controlling rodents. The rats destroy our grain and this damage is vast In South India severe loss occurs

because of rats who destroy tea plants by nibbling the roots. In West frogs are imported as a source of protein from developing countries. Frog (*Rana tigrina*) is being captured in great no. from many areas. Frogs play a vital role in controlling malarial parasite as they feed on it. In this way they help in checking malaria disease. Besides they also feed on vast quantities of insects and give a natural biological control. Lands have a unique productivity of their own as well as the ability to sustain large quantities of wild animals which could be useful for their hides, meat and other products. The Indian Nilgai and gazelle, also antelopes like black bucks, do exceedingly well in arid lands. Ecologists thought, that wild life is an essential part of our ecosystem and its activities are important for keeping wild vegetation in good health. Grazing is necessary to keep plants and grass in optimum condition.

Indian region is a treasure house of wild genetic resource. Wild species and relatives of crop plants contain value genes that are of immense genetic value in crop improvement programmes. The important wild related species and types in various crop groups, prevailing under different phytogeographic zones of the country needs particular attention in the agro-biodiversity management system for a sustainable use to help maintain nutritional and agricultural economic security.

VII. MEASURES OF BIODIVERSITY CONSERVATION

- 1) World Wild Foundation for Conservation of Nature & Natural Resources (WWF)** - is managed by a board of trustees. The WWF was established at Switzerland. Giant Panda is its symbol.
- 2) Red Data Book** - IUCN started its publication on plants and animals. This book contains the complete list of all endangered animals plants was published by Botanical Survey of India in 1987. The RDB is supposed to keep a full record of all endangered species.
- 3) Wild Life Preservation Society** – It is a non-government organization founded in 1958 by wild life lovers. It spreads awareness among people for protection of Wildlife & environment & publish a quarterly journal named Cheetal from Dehradun
- 4) International Union for Conservation of Nature and Natural Resources** – This is an international agency and its Head Quarter is in

Switzerland. It is the scientific advisor of WWF. Many nations and private institutions are its members.

- 5) Principles of State Policy** - The need of wild life protection is considered by our constitution. It emphasizes that states would ensure to protect and improve the environment and to safeguard the forests and wild life of the country. It states that it would be the duty of each and every citizen of India to protect the natural environment like wild life, rivers, lakes, forests and soils etc.

VIII. INDIA AS A MEGA DIVERSITY NATION

In India, about 1,15,000 species of plants and animals have been identified and described. For example, the following crops occurred in the country and spread throughout the world: Rice, sugarcane, Asiatic vignas, jute, mango, citrus, banana, several species of millets, several cucubits, some ornamental orchids, several medicinal and aromatics. In fact, the country has been recognized as one of the world's top twelve mega diversity nation. This region is also a secondary centre of diversity for grain, amaranthus, maize red pepper, soyabean, potatoes and rubber plants.

In animal, the rate of endemism in reptiles is 33% and in amphibians 62%. Further there is a wide-diversity in domestic animals such as, buffaloes, goats, sheeps, pigs, poultry, horses, camels and yaks. Domesticated animals have come from same cradles of civilization as also the major crops.

Information regarding other flora and fauna are patchy. Hundreds of new species may be present in the country awaiting discoveries. The Western Ghats in paninsular India, which extend in the southern state, are a treasure house of species diversity and has about 6,000 species. It is estimated that almost one-third of the animal variety found in India have taken refuge in Western Ghat of Kerala alone.

The Indian Gene Centre is among the twelve mega diversity regions of the world. More than 20 crop species were domesticated here. It is known to have more than 49,000 species of plants, 18,000 species of higher plants, including major and minor crops (166) and their wild relatives (326). Around 1,000 wild edible plant species are widely exploited by native tribes. These include 145 species of roots and tubers, 521 of leafy vegetables, 101 buds and

flowers, 647 of fruits and 118 of seeds and nuts. In addition, nearly 9,500 plant species of ethnobotanical uses have been reported from the country of which around 7,500 are of ethnomedicinal importance and 3,900 are multipurpose and edible species.

HOT SPOTS OF BIODIVERSITY

The earth's biodiversity is distributed in specific ecological regions. There are over a thousand major “ecoregions” in the world. Of these 200 are said to be the richest, rarest, and most distinctive natural areas. These areas are referred to as the Global 200. It has been estimated that 50,000 endemic plants which comprise 20% of global plant life, probably occur in only 18 hot spots in the world. Countries which have a relatively large proportion of these biodiversity hotspots are referred to as mega-diversity nation:

Global species diversity are :-

Bacteria and blue green algal- 4760 species, fungi 46983, algae 26900, Bryophytes 17000, Gymnosperms 750, angiosperms 250000, Protozoan's 30800, sponges 5000, corals and jellyfish 9000, Roundworms and earthworms 24000, crustaceans 38000, Insects 751000, other arthropods and minor invertebrates 132,461, mollusks 5000, starfish 6100, fishes 19056, Amphibians 4180, Reptiles 6300, Birds 9198 and mammals 4170 species.

The rate at which the extinction of species is occurring throughout our country remains obscure. It is likely to be extremely high as our wilderness areas are shrinking rapidly. Our globally accepted national hotspots are in the forests of the North-East and the Western Ghats, which are included in the world's most bio-rich areas. The Andaman and Nicobar islands are extremely rich in the species and many subspecies of different animals and plants i.e. there species funnel only in India; a large proportion are concentrated at these areas. The Andaman and Nicobar Island alone have as many as 1200 species of flowering plants and 120 species of ferns. Out of 135 genera of land mammals in India, 85 are found in the North-East. The North-East states also have 1500 endemic plant and reptile species. Western Ghats is also a habitat for 1500 endemic plant species.

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Behavioural Ecology of Blackbuck (*Antilope cervicapra*) in Bhetnoi-Balipadar area of Ganjam District of Odisha, India.

Debiprasad Sahoo, C. S. Kar

Introduction:

The blackbuck is considered to be the most beautiful of all antelopes because of the male's striking black and white pelage and his long spiral horns (Schaller, 1967). Blackbuck is included in the Schedule-I of Wildlife (Protection) Act, 1972 and is designated as Vulnerable as per Red Data Book. In India the species is wide spread in Rajasthan, Gujarat, Madhya Pradesh, Tamilnadu and other areas throughout peninsular India. Their number reduced drastically between 1982 and 1993, from about 25,000 to as less as 10,000 in the whole country. In Odisha, in the past, this species was occurring in Balasore and Puri Districts and very scarcely in Bolangir and Kalahandi districts and also in coastal sand dunes of Bhitarkanika and Kujang area. In the current situation, blackbuck in Odisha is confined to certain pockets like Balipadar – Bhetnoi and adjacent areas in the Ganjam district and, Balukhand – Konark wildlife sanctuary and coastal plains in Puri district. However, the degradation of habitats and indiscriminate poaching contributed to the reduction in the population. Even in the Konark-Balukhand Sanctuary created for their protection, their presence is doubtful since after the Super cyclone of 1999, they have not been seen by the local people who believe that either they died in the cyclone or migrated to other areas (Rath & Rao, 2005). However, looking at the present population of the animal in the State it is evident that the population in Balipadar-Bhetnoi makes a larger percentage of the total in the State (Mohanty, 2011). Therefore study on the behavioural ecology of this threatened species in the study area will be helpful for better conservation of this species.

Study area:

The study was conducted in Ballipadar -Bhetnoi Blackbuck habitat in Buguda and Aska Ranges of Ghumusar South Forest Division in Ganjam district. The area lies between 19°35'-19°55'N latitude and 84°35'-84°50'E longitude covering an area of 64.21km² (Kar, 2000). Its northern and western boundaries touch the river Badanadi near Kumarsuni Reserve Forest, southern part touches the bank of river Rushikulya and river Baghua runs along its eastern boundary. The habitat extends beyond the boundaries in Polasara and Jagannathprasad range of Ghumusar South and Ghumusar North Forest Divisions as blackbuck population are also seen in some

isolated pockets. The state highway-33 connecting Berhampur to Nayagarh via Buguda passes through the study area.

Methodology:

Study was conducted for a period of five months from August 2012 to December 2012. Following methods are used to study behavioural ecology of blackbucks.

(1) Selection of study sites according to distribution of blackbucks with good population.

(2) Observations are made by direct sighting.

(3) Continuous and regular observations are made.

Results and Discussions:

Observation on feeding behaviour of blackbucks:

It is observed that blackbuck is grazer in its feeding habit and grazes on three types of forage such as grasses, herbs and cultivation (Due to availability of paddy crops in the study sites grazing on paddy crop cultivation is observed). Detailed observation on feeding behaviour at different study sites of Aska Range is given in table-1. In one social group one type of feeding by group of individuals is considered as one observation.

Total 133 observations on feeding behaviour of blackbucks were made from five major study sites of Aska Range. Out of 133 observations grazing on grasses is maximum (90 observation, 67.6%) followed by herbs (30 observations, 22.5%) and cultivations (13 observations, 9.7%). From this it is clear that preference of forage for blackbuck is grass, then herbs and feeds on cultivations if available.

Table-1: Feeding observation of blackbucks at different study sites of Aska Range

Study sites	No. of feeding observations on different types of forage			Total no. of observation
	Grass	Cultivation	Herb	
Jagatipadia	59	5	16	80
Jorjipadia	4	2	2	8
Chhatapadia	3	1	2	6
Brahmanabagada and Nayakabagada	8	1	1	10
Kharia Rasta	16	4	9	29
Total no. of observation	90	13	30	133

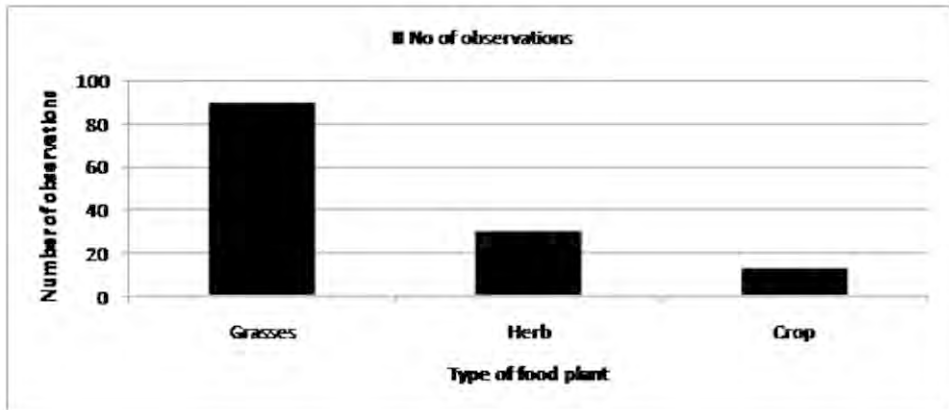


Figure-1: Observation on forage preference of blackbucks

Grooming behaviour in Blackbucks:

After a continuous observation on grooming behaviour of blackbuck it is found that grooming body with help of muzzle and hind leg is not only to get relief from itching but also to keep body clean.

The behaviour was studied on a experimental basis for 10 days on a herd consisting about 37 members taking two parameters into consideration such as grooming behaviour after resting period (till half an hour after resuming activities) and grooming during active periods (Study for half an hour during active behaviours like grazing, aggressive, standing, playing etc.). An average number of individuals involved in grooming during these two periods were recorded. It was observed that during the observation periods average of 28 individuals were involved in grooming after resting period where as an average of 16 individuals were involved in grooming during active periods. As most of the grooming activities are observed after resting on grasslands, therefore grooming behaviour seen in blackbucks involves cleaning body besides getting relief from itching.

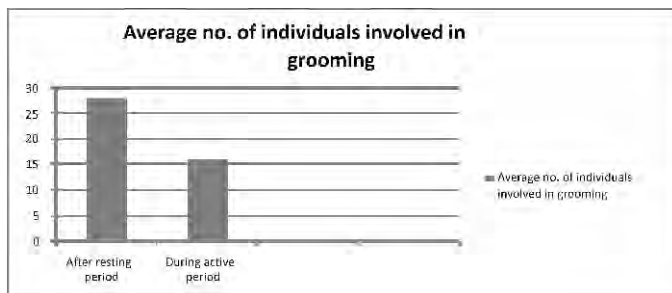


Figure 2: Average no. of individuals involved in grooming during the observation periods

Behavioural relation of adult male Blackbuck with respect to its ear and tail position:

It is observed that the ear and tail position of adult male blackbuck is related with its behavioural expression. Three types of ear and tail positions such as upward, downward and horizontal are observed. During normal behaviour, ear remain upward and tail downward. In excitement or fear situation ear remain downward and tail upward. Horizontal position of ear and tail refers to excitement or fear at lower intensity after which ear and tail take downward and upward position respectively at higher intensity & excitement

Behavioural observations of adult male blackbucks along with ear and tail position at different study sites were recorded to know the relationship between body position and behavioural expression in adult male blackbucks. Only such behaviours were recorded with which ear and tail position is related. Out of 188 observations on ear and tail position of adult male blackbucks with different behavioural activities upward ear and downward tail position was observed 117 times (62.2% observation). This type of body position includes behavioural activities like grazing, standing, wandering, looking forward and fleeing away. Downward ear and upward tail position was observed 54 times (28.7% observation) and includes behaviours like alarming, head-up display and approaching female. Both horizontal or downward position of ear and downward or upward position of tail was observed only 17 times (9.04% observation) and includes behaviours like galloping, chasing and fighting. The detailed observations on ear and tail position of adult male blackbucks with relation to different behavioural activities are given in table-2.

Table-2: Observations on ear and tail position of adult male blackbuck with respect to its behaviours.

Sl.No.	Ear position	Tail position	Type of behaviour	No. of observation
1	Upward	Downward	Grazing	40
2	Upward	Downward	Standing	34
3	Upward	Downward	Looking forward	27
4	Horizontal/ Downward	Downward/Upward	Galloping	5
5	Downward	Upward	Alarming	21
6	Upward	Downward	Wandering	11
7	Horizontal/ Downward	Downward/Upward	Fighting	4
8	Downward	Upward	Head-up display	17
9	Upward	Downward	Fleeing away	5
10	Horizontal/ Downward	Upward	Chasing	8
11	Downward	Upward	Approaching female	16

From the above discussions and observations it is clear that during normal behavioural activities adult male blackbuck keep its ear upward and tail downward where as during excitement or fear situations they keep their ear downward and tail upward.

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Maneating leopard of Chandbari.

***Dr. Prashant Singh**



2-11-2013 Birori Village. Dhaulas range.

It is amongst the darkest nights of the year. A night before Dewali, a time when most people are wearing their best clothes and lighting their homes to celebrate the festival of lights. The 3 idiots (as our respective wives collectively call us) are out in the cold. Dressed in cammo, rifle in hand, stalking a maneater.

1. Kr Sanjay Singh: Registered Shikari with the state govt. since 1998. This is the tenth maneater he is going after. His old faithful .315 rifle in hand.

2. Mr Sudhir Raghav: With hunting experience from Russia. Sudhir is a national level shooting champion and loves the 12 bore dbbl gun.

3. Dr Prashant Singh: With hunting experience from Africa and England. Prefers a 30-06 telescopic rifle.

All the hunters are life members of the Wildlife Preservation Society of India.

We have spent a week searching the Birpur, Ghangora, Chandbari area and have seen a couple of leopards. The area consists of a Cantt. speckled with villages around a thickly forested

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area in the foothills of Mussoorie.

Surprisingly. The thick Sal jungles appear to be devoid of all natural prey. We spot no wild boar, no barking deer, no porcupines. We neither hear any peacocks or red jungle fowl during the day. We do see a few hare and monkeys here and there but otherwise there is hardly anything worthwhile for the big cats to eat. Looks like the villagers have poached out most of the leopard's food. Outside the jungles on the roads and near human settlements, there are enough dogs and feral cattle which appear to be the main prey base for these cats.

The first kill was a 16 year old girl. The attack took place just above the Chandbari shooting range in thick Sal forest. What was the girl doing there in the first place? "Can't really blame the leopard when someone enters right inside it's home". Sanjay tells the forest guard who is guiding us to the spot.

"This is not a maneater. If it doesn't strike again. I will call off the hunt and consider it as an accident. If it strikes again it will have to be put down." he continues.

We spend 6 nights thereafter looking for the culprit. During the search we come across two leopards.

One of them is a young fellow. It is rather small in size and Sanjay is sure it could not have killed the 16 year old girl. "Look at the oversized ears". Sanjay says. "This is a little chap who can't be the killer". This leopard is spotted in the clearing behind the Officers Mess. He doesn't give us much time and is soon lost in the bush.

The other one is a big male. He has been spotted by a number of people. Comes close to human habitation and is an initial suspect. We get a call from some soldiers on the 31st night (Oct). It



has rained in the evening and the ground is wet. The leopard has been sitting on a tree for half an hour. We ask them not to disturb the animal and reach the spot as soon as possible. To our surprise the beast is still there. Sanjay and I crawl up to a lantana bush. I place my shooting sticks (bipod) and rest my rifle on it. The leopard is stretched out on a thick branch of an old dry tree with his tail hanging down. The cross of my scope is placed just behind the front shoulder for a perfect heart and lung shot. My index finger is stretched out straight away from trigger. A squeeze of the trigger and the 180 grain soft nose bullet should bring the animal down immediately. Sanjay pulls up the binoculars and takes a good look. The soldiers have their torches focused on him. They are whispering from behind. "Maar do saab" (shoot him saab). Sanjay stands up slowly and walks towards the side. I follow him. The leopard gives us a glance but is not affected. The whispering amongst the soldiers now gets louder. "Maar kyun nahi rahe? Maar do saab." The leopard is still there. A sitting duck for even an amateur shikari. An easy game. I had read leopards are cunning and smart. Specially maneaters. This one doesn't behave like one. Why is he still sitting there. Sanjay and I are now hardly 20 yards from the majestic beast. The big male has a beautiful dark color. His tail is thick and all black at the tip. He is surely more than seven and a half feet. A most beautiful trophy by any standards. But we are not here on a trophy hunt. We are here to shoot the maneater. We watch him for another 15 minutes. Finally he gets so fed up with all the torch light on his face that he gets up, comes down the tree and finally jumps into the thick undergrowth. For a moment I am spell bound by his beauty. I only wish I had my camera instead of the rifle. The soldiers are very upset. "Why didn't you shoot the leopard?" They question. Sanjay explains "this is not the maneater". Didn't you see his behavior. He is not after us. We had the rifle on him. We could have easily shot him. But he just ignored us. He can surely not be a man killer. He has no interest in us. Even when we had all the lights on him. He did not

get agitated. Only when we really got very close to him and started talking loudly, did he get up and walk away. He has been there for more than 45 minutes now. He has been there looking for his prey.....and we do not feature on his menu card yet." He joked.

A couple of days later. 2nd of November 2013. 7 p.m.

We get a call that a 9 years old girl has been killed. We rush to the spot and reach Birori village (a distance of less than 3 miles from Chandbari village---as the crow flies). We get down from the SUV and load our weapons. The girl has just been killed. The villagers have got together and pulled the dead girl away but the leopard is still there. Waiting to get a chance to feed on it's fresh kill. We see blood on the ground and follow the trail. We come upon the girls chappals with blood here and there. We ask the villagers to stay back and make a single file. Pandit ji, the driver given by the Forest Dept. holds the flash light. Though unarmed. He walks bravely behind us. He assures us that whatever happens he will not move the light away, once we come upon the killer. Every step is taken with caution. The leopard is the fastest, most cunning and clever amongst all big cats. In these conditions, it can see and hear 6 times better than humans. This is his land and we are mere trespassers. No doubt we are armed. But I have all respect for this most graceful of predators.

As we move forwards. I see a pair of eyes shining through the darkness. Two burning ambers from behind a bush. As the flashlight fixes on the eyes I see the leopard broadside. A flick of the tail and the leopard charges towards us. We are hardly 30 yards from the animal. Almost simultaneously all guns boom. Bang. Bang. Bang. Reload. Bang. Bang. It's all over.

A quick end to the reign of terror. The maneater turns out to be a 8 year old female leopard. When I sit next to the dead leopard my mind is overwhelmed with emotion. On one hand I am glad that we have killed the maneater and no more human lives will be lost. On the other hand I feel sad for the plight of leopards and all wildlife in an ever shrinking habitat.

A couple of days after killing the maneater. I am still getting calls from the locals. They are spotting leopards in different parts. I assure them that the killer has been terminated and they need not fear. Then I read news reports from local news papers which are adding to the fear. I soon realise that killing the maneater is only half the job done. Eradicating the fear from the peoples' mind is the other half.

I request Mr Vinod Rishi ret'd. I.F.S. officer to help educate the locals. My fear is that the innocent leopards in the area should not be victimized.

Mr Vinod Rishi (also a life member of the W.P.S.I.) agrees to give an educational talk to a house full auditorium. The talk is an eye opener not only for the locals but also for me. Mr Rishi talks about how the leopard has adapted itself to urbanization. How they have changed their diet which now includes 95% domestic animals with as much as 60% of the diet being dogs.

His closing words come back to my mind again and again : "If the Tiger is the KING of the Indian jungle, the Leopard is the uncrowned PRINCE".

No doubts about that.

Nature Notes

Death on the wrong flank

***Sargam Ssingh Rasaily**

"Sir, there is no point in putting the camera traps. No animal will ever come near this carcass, not to talk of scavenging on it," declared one of my staff. I looked up to him and asked, "Why do you say that? Why wouldn't a Hyena or a vulture eat from this perfectly good carcass?"

"Because the animal is lying on its left shoulder," he said knowingly.

The patrol team from the Rawasan Forest Chowki at the eastern border of Rajaji National Park came across a carcass of a she elephant lying on the side of an animal tract. The tract went along the contour on the slope of a small hill, on the Shivalik ridge. On receiving the information, I immediately went to the site. Ocular examination revealed no external sign of injury or disease and surprisingly, there was no sign of death throes either. Usually before an animal dies, it throws around its legs and leaves behind signs of struggle before finally ceasing to breathe and for an animal of the size of an elephant, signs of death throes are unmistakable. However, in this case, the animal appeared to have simply dropped on its side and dozed off to death!

As mandated for all Scheduled-I species, postmortem was conducted without losing much time. Careful and detailed examination of the carcass revealed no apparent cause of death. The elephant appeared to be healthy and free from any disease or major infestation. All the internal organs looked fresh and without discoloration or disfigurement. There was no apparent cause of the animal's death and the animal appeared to have died a natural death due to old age.

After the postmortem, there arose the question of the disposal of the carcass. The usual method of disposing off an animal carcass in the Park was to bury it on site but after taking over charge of the Park, I decided to discontinue this ecologically wasteful way and leave the carcass for the scavengers to feed on. But, this method was to be followed only when the cause of death was known for sure and there was no chance of spread of disease or cause death of scavengers by the consumption of flesh of an animal that has died due to poisoning. In this case, the cause of death of the animal could not be ascertained for sure; therefore, it was important that the carcass should be

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disposed off either by cremating or burying. However, since the carcass was up on the hill and that too, way away from the nearest road, it was neither possible to take an excavator to the site to dig a hole big enough to bury the elephant nor was it possible to dig it manually. Cremation was the other option but it was fraught with the danger of starting a forest fire in that fire sensitive part of the Park. Therefore, there was no option but to leave the carcass for the scavengers to take care of.

Sensing a good opportunity to record the activities of the local scavengers such as the Stripped Hyenas, vultures, Wild Pigs etc. in this part of the Park, I decided to place some camera traps around the carcass. In order to make the carcass more visible to the vultures, we lopped some branches off the nearby trees and placed three well-hidden and camouflaged cameras traps around the carcass (*it is important to note that such activities never seem to bother the scavengers who come to feast on the carcass*). It was when I was supervising the mounting of the Camera Traps, my staff made the above remark. However, being sure that contrary to my staff's prediction, I would have some good pictures of scavengers feeding on the carcass, I continued to place the camera traps and left the place completely deserted. Since the site was deep inside the forest where it was not possible for our staff to go daily, we could collect the camera only after three or four days.

To my utter surprise (but not that of my staff), we found that not a single animal had visited the carcass. Even the staff who had gone to collect the camera in the daytime reported that they saw few vultures perched on a tree at a distance but there was no tell tale sign of the carcass having been visited by the vultures or any other animal. Not only the carcass but the very site had completely been shunned by all species of scavenging birds and animals in the Park!

Many times before and after this incidence, I have left many elephant carcass in the open for the scavengers to feed on and every time I have found series of animals taking full advantage of the free meal. I have photographed hordes of Wild Pigs feeding on the carcass during the night, vultures during the daytime and I even have seen birds like the Red Jungle Fowl feeding on the maggots during the early mornings followed by the Pea fowls during the daytime. However, I am at loss to explain why the carcass of an elephant lying on the 'wrong flank' was completely ignored by the hordes of ever-hungry scavengers that abound in Rajaji National Park. I would like to know if there is any record of such incident elsewhere or any rational explanation for it. Till such time, it will always remain a mystery for me; this phenomenon of the 'Death on the wrong flank'.

STUDY ON AQUATIC BIRD DIVERSITY OF TARADIA DAM IN MAYURBHANJ DISTRICT, ODISHA, INDIA

Debiprasad Sahoo¹, Sandeep Ranjan Mishra²

Introduction

Birds are one of major component of our environment which enriches the biodiversity. India harbours 1200 species of birds among 13% of the total bird species of the world (Ali and Ripley, 1983). In India Eastern Ghat is one of the major biodiversity areas and State Odisha comes under it. The avifauna of Odisha have mainly studied by Mukherjee (1952), Ripley (1979), Abudalali (1984), Majumdar (1988), Sahu & Kar (1999), Sahu & Rout (2005), Gopi & Pandav (2007) and Das et al. (2010). Aquatic birds form one of the fascinating species of birds and are of environmental and economic value. Most of them feed on mosquito larvae, aquatic vegetations etc. making water pollution free. Some of them are winter migrants coming from far distance. Thus study on the diversity of aquatic bird is important. The present study aims to document diversity and number of aquatic birds available in Taradia dam, Odisha which is a lesser known place but contiguous to Similipal Tiger Reserve and also rich in waterfowl diversity.

Study Area

Taradia dam (21°18'35.9"N and 86°06'19.9"E) comes under Satkosia Range and Karanjia Division of Mayurbhanj District, Odisha. Sal forest forms the major vegetation of the contiguous Satkosia reserve forest which is contiguous to Similipal Tiger Reserve and considered as buffer zone of Similipal Biosphere Reserve. Agricultural cultivations are found surrounding the dam which is the main livelihood of income of the local tribal. Annual rain fall is more than 1800mm.

Methodology

The census operation was carried out on 19th January 2013 between 6.30 am and 11.00 am. Observation was based on direct sighting with aid of 8x40 Bushnell binocular and identified by using field guide book of Grimmett et al. (1999) and Salim Ali (The book of Indian Birds, Thirteenth edition). The species of bird sighted and its number was recorded in the note book before putting the final data in the Bird Count Form. The final details about the number and species of bird were recorded on the

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Bird Count Form.

Result and Discussion

A total of 12 species and 49 numbers of aquatic birds were recorded during the study period. These belong to family Podicipitidae, Pelecanidae, Ardeidae, Jacanidae, Charadriidae. Open bill stork and Great crested grebe were found in good numbers where as three species of Egrets, Red wattled lapwing, Yellow wattled lapwing, Bronze winged jacana, sand piper, plover were also recorded. A detail account of the sighted species, number and family it belongs to is given in table-1. Human disturbance in the form of cattle grazing in the shore bed and fishing activities were recorded during study period. Fishing activities seems to be one of the threats to the aquatic birds affecting their population.



Location Map of the Study area

Table 1: List of aquatic birds found in Taradia dam

SL No.	Species	Zoological Name	Family	Number of Birds sighted
1	Lesser Whistling Duck	<i>Dendrocygna javanica</i>	Podicipitidae	7
2	Little grebe	<i>Tachybaptus ruficollis</i>	Podicipitidae	1
3	Little cormorant	<i>Phalacrocorax niger</i>	Pelecanidae	3
4	Cattle egret	<i>Bubulcus ibis</i>	Ardeidae	2
5	Little egret	<i>Egretta garzetta</i>	Ardeidae	6
6	Median egret	<i>Mesophoyx intermedia</i>	Ardeidae	1
7	Asian open bill stork	<i>Anastomus oscitans</i>	Ardeidae	11
8	Bronze winged jacana	<i>Metopidius indicus</i>	Jacanidae	2
9	Red wattled lapwing	<i>Vanellus indicus</i>	Charadriidae	3
10	Yellow wattled lapwing	<i>Vanellus malabaricus</i>	Charadriidae	6
11	Wood sandpiper	<i>Tringa glarcola</i>	Charadriidae	1
12	Common greenshank	<i>Tringa nebularia</i>	Charadriidae	3
13	Little ringed plover	<i>Charadrius dubius</i>	Charadriidae	3

हिमालय की अमूल्य धरोहर महासीर मछली विलुप्ति के कगार पर।

* डॉ० सत्य प्रसाद बडोला
मत्स्य वैज्ञानिक

गढ़वाल एवं कुमायूँ हिमालय में महासीर एक प्राकृतिक धरोहर है। जो कि हिमालय की बड़ी नदियों की सबसे बड़ी मछली है। संकट ग्रस्त महासीर मछली वर्तमान में अपने बचाव के लिए संघर्ष कर रही है। यदि उसके संरक्षण के लिए मत्स्य वैज्ञानिकों, पर्यावरणविदों एवं सरकार ने समय पर चिंतन नहीं किया तो ऐतिहासिक मछली विलुप्त हो सकती है। महासीर मछली की उपयोगिता का विवरण वेदों एवं मनुस्मृति में भी किया गया है। वेदों में इस मछली को बड़े सिर होने के कारण महासीर कहा गया है। वहीं मनुस्मृति में इसके शरीर में बड़े-बड़े शल्क होने के कारण महाशल्का भी कहा गया है। वैदिक युग में इसके मांस को वन में विचरण करने वाले साधू-सन्यासी व ब्राह्मणों को सम्मान के साथ दिया जाता था। विष्णु स्मृति में तो यहाँ तक कहा गया है कि इसके मांस को अवश्य ग्रहण करना चाहिए। मनुस्मृति के अनुसार इसके मांस को लोग अपने पूर्वजों की आत्मा की शांति के लिए संत एवं ब्राह्मणों को इसका भोज कराया करते थे।

महासीर मछली मध्य हिमालयी क्षेत्रों में बहुतायत में पायी जाती है। गढ़वाल एवं कुमायूँ हिमालय से लेकर जम्मू-कश्मीर, हिमाचल प्रदेश, नेपाल एवं भारत वर्ष के अन्य पर्वतीय क्षेत्रों में भी महासीर की विभिन्न प्रजातियाँ पायी जाती है। प्राप्त विभिन्न ऐतिहासिक अभिलेखों के अनुसार यह लगभग एक मीटर लम्बी एवं एक किन्टल भार तक की पायी जाती है। पौष्टिक तत्वों की बहुतायत एवं अधिक स्वादिष्ट होने के कारण इसका मांस बड़े चाव से खाया जाता है।

गढ़वाल हिमालय की गंगा, यमुना, सौंग, सुसवा, नयार, हिवल, गूलर, खोह, मन्डाल, रामगंगा एवं कुमायूँ हिमालय की कोसी, गोमती, सरयू, गौला, गगास, गोरी, काली, पूर्वी रामगंगा आदि प्रमुख नदियों में प्राकृतिक रूप में निवास करती हैं। इस संकट ग्रस्त महत्वपूर्ण मत्स्य प्रजाति को बचाने के लिए प्रयत्न किये जाने की नितान्त आवश्यकता है। विशेषरूप से नदियों में डायनेमाइट, विद्युत करेन्ट एवं विषैले रसायनिक डाल कर उनके सम्पूर्ण वंश (वयस्क, बच्चे एवं अण्डों) को क्षतिग्रस्त किया जा रहा है। इस पर पूर्ण प्रतिबन्ध लगाया जाना चाहिए। हाल ही में कोटद्वार के समीप स्थित खोह नदी में मत्स्य विविधता के परिस्थितीकी तन्त्र को क्षतिग्रस्त करने के लिए उत्तरदायी असामाजिक तत्वों द्वारा डाले गये विषैले रसायन के विष के प्रभाव से मृत मछलियों में अधिकांश महासीर के बच्चे देखे गये हैं क्योंकि इस समय महासीर का प्रजनन काल होता है।



* R/O of Kotdwar Distt. Pauri Garhwal, Uttarakhand

Cheetal Quarterly News

ODISHA GOVERNMENT HONOURS DR L. A. K. SINGH WITH BIJU PATNAIK AWARD FOR WILDLIFE CONSERVATION



At a state function held on the 7th October 2013 at Bhubaneswar to celebrate the 59th Wildlife Week, Sri Naveen Patnaik, the Chief Minister, Odisha presented the State level Biju Patnaik Award for Wildlife Conservation jointly to Dr. Lala Aswini Kumar Singh and Shri Swaraj Kumar Kanhar. The Award carried cash prize of Rupees one Lakhs each, a Memento, a Certificate and Citation.

Dr Lala A. K. Singh is a Life Member of the WPSI since 1976, and was formerly Senior (Wildlife) Research Officer under the Forest and Environment Department, Odisha.

The professional career of Dr Singh as wildlife researcher, academician and institute manager spans over thirty-eight years. Dr Singh has been involved in Crocodile Conservation programme at its inception and published a large number of research papers on wildlife ecology and management. Dr Singh has refined the old pug mark technique & has made it more reliable by his innovative work of supplementing techniques to distinguish tracks of tiger cubs and adult leopards. Dr Singh has also propounded the idea of aberrant tigers in various colours in his work “Colour Aberration in Tiger and its Conservation Implications.” Dr. Singh received the WWF-India award and medal in 1999 for innovative and significant contributions towards tiger conservation. He received fellowship from Conservation Treaty Fund-USA for Animal Management Course from National Extension College, Cambridge in 1991, and the Chaturvedi Prizes from FRI, Dehradun for the best Wildlife articles published in 'Indian Forester' in 1983-84 and 1990. Presently Dr Singh is obliging short-duration consultancies, and serving as member of Odisha State Board for Wildlife and Odisha



Ecotourism Board.

The other recipient of Biju Patnaik State Award this year, Shri Swaraj Kumar Kanhar, is a Social Worker from Boudh District, and is working as the Honorary Wildlife Warden of the District from the year 2009.

Sri Kanhar received the “Prakruti Bandhu” award during the year 1997-98 in the District of Boudh and “C.P.R Environmental Education Centre Award 2007” from “Dr. M. S. Swaminathan Institute, Chennai”.



In his address to the audience, Hon'ble Chief Minister reaffirmed commitment towards protection and conservation of wildlife and their habitats. He stressed about the implementation of the scheme worth RS.21.00 crore for developing traditional elephant corridors to avoid man-animal conflict. The scheme involves programmes for reducing death of elephants due to electrocution and train-hits. The Hon'ble Chief Minister informed about steps taken to generate employment opportunities for local forests dwellers through eco-tourism. He solicited the co-operation of the people of Odisha for more effective protection of wildlife and their habitats.

School students and thirty-three Sub-Division level workers were encouraged with prizes from the Chief Minister. Hon'ble Chief Minister, released three publications on the occasion. These are, "Wildlife Odisha-2013", "Standard Operating Procedure to deal with emergency arising due to straying of wild animals in human dominated landscapes" and "A field Guide on Birds of Chilika".

Maharaja Nabha Memorial Declamation contest-2013

To commemorate the memory of H.H. Late. Col. Maharaja Sir Pratap Singh Malvendra Bahadur K.C.S.I, Maharaja of Nabha who was instrumental in creation of Wildlife Preservation Society of India Dehradun and was the founder president and Life long Patron of the society, a declamation contest was started which will be held during Wildlife Week every year. The contest has been named as “Maharaja Nabha Memorial Declamation contest” and the winning school will be awarded with a

running trophy. Any school winning the contest for three consecutive years will be allowed to retain the trophy.

The contest for 2013 Wildlife Week was held on 4th October 2013 in FRI Deemed University. The Participants for this year were:

1. Asian School Dehradun
2. Welham Boys School Dehradun
3. Raja Ram Mohanroy Academy Dehradun
4. K.V. FRI Dehradun
5. Scholars Home School Dehradun
6. St. Thomas School Dehradun
7. Jaswant Modern School Dehradun

A total of 21 student participated in the contest. The contest was witnessed by the teachers and guardians of the students, M.Sc Forestry students and faculty of FRI Deemed University, Members of WPSI and other distinguished persons. The topic was “Man and Wildlife conflict”. The contestants were from class VII to XII. The performance of all the contestants was appreciable as all of them spoke to the point on the subject. The panel of judges consisted of:

1. Mr. Vinod Rishi Retired Addl. DG Wildlife MOEF GOI.
2. Mr. Dhananjay Mohan IFS, Chief Conservator of forests Wildlife Uttrakhand
3. Dr. Parshant Singh a renowned Dentist, Member WPSI and keen Wildlife Photographer

The following were the winners of the contest.

- 1st Prize- Rahul S. Markande Class XII, Scholars Home School
- 2nd Prize- Ananya Bahukhandi Class XI, Raja Ram Mohan Roy Academy
- 3rd prize- Pratishtha Bhatt Class XI, St. Thomas School

Consolation prize - Jessica Robin class IX, Scholars Home School

The “Maharaja Nabha Memorial Wildlife Preservation Trophy” was bagged by St. Thomas School Dehradun. The prizes were given away by Smt. Sinha (W/o Mr. Samir Sinha IFS CCf and Director CTR) The gathering was addressed by Mr. Vinod Rishi, A.s Negi President of the Society and Mr. RP Kala Hony Secretary of the Society.

Painting competition held during Wildlife Week-2013

A Painting competition was held during Wildlife Week 2013 in which following schools Participated.

Welham Girls School

Jaswant Modern School

KV.FRI

A large number of students from three categories, viz, cubs, junior and senior

participated in the competition and drew beautiful paintings on the following themes.

Cubs – My favorite Wild animal

Juniors – Birds – The friends of man

Seniors – Wildlife Preservation and ecological stability

The entries were judged by a panel of judges and category wise prize winners were as under.

Cubs - 1st - Abhas Saxena IV B, KV FRI
 2nd – Jashan preet Singh III B, KV FRI
 3rd – Esha Thakran V, Welham Girls School
 Consolation - Anuj Jugran IV B, KV FRI

Juniors:

 1st Anamika Roy VI B, Jaswant Modern School
 2nd Lakshita Jamwal VII, Welham Girls School
 3rd Urvi Singh VIII, Welham Girls School
 Consolation - Palaksha vashistha VIII, KV FRI

Seniors:

 1st Sanjana Singh XI, Welham Girls School
 2nd Padmawati XII, KV FRI
 3rd Shatakshi Kalki XII, Jaswant Modern School
 Consolations- Supriya Gauniyal X, Jaswant Modern School.

KV FRI bagged the trophy for the overall performance in the event.

The prizes were awarded in the functions held on 4th October 2013 in FRI Deemed university along with the prizes of Declamation contest.



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THE WILDLIFE PRESERVATION SOCIETY OF INDIA

(Established 1958)

Heritage Appartment Flat No. 2 First floor, 18 New Road, Dehra Dun.

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My interests are

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(April to March) |
| 4. | Students (School) | Rs.200.00 per annum |
| 5. | Affiliated : | |
| | (Others similar bodies) | |
| 6. | Institutional | |
| | (Messes, Units, Schools, Colleges,
Govt. Deptts., Corporations,
Societies, NGOs etc.) | Rs.500.00 per year |
| 7. | Institutional Life | Rs.5000.00 |

All Communications may please be addressed to the Hony. Secretary.

Signature

Signature

Wild Life Management In India

*M.D. CHATURVEDI

"What matters is not the trophy but the race; not the quarry, but the chase."

1. Distribution of Wild life

1. A reference to the birds and animals living in ecological balance with their surroundings provides the background for wild life management. The environment, both animate and inanimate, determines the evolution of animal life in a given region. There is no better indicator of environment than vegetation which reflect reaction to the climate, edaphic, and biotic factors. In the ultimate analysis, vegetation, on which all wild life depends directly or indirectly for its sustenance, determine the protective colouration, the size, the character and the distribution of birds and animals. It is their habitat from which animals derive their habits.

2. The physical regions distinguished in India for the description of its vegetation, provide the best basis for a detailed consideration of its rich and varied wild life. No less than 500 species of mammals, 1100 species of birds and 350 species of raptiles occur in the country. Of these, the Flying Lemur, which bears the same relation to the shrews as the flying squirrel does to the squirrels, and the Scaly Ant-eater reminiscent of reptiles, constitute breath taking curiosities. Another celebrity is the little Painted Bat (*Kerivuala picta*) with its vividly coloured vermilion and black wings (18). The regional distribution of wild life is outlined below :

(1) The Deccan

(a) The West Coast

2.1 The luxuriant rain forest and *sholas* support a rich and varied wild life. Species characteristic of this wet region (rainfall; 150 to 200 inches) are the Nilgiri Langur(*kashi johnii*), the lion - tailed macaque (*Macaca silenus*), the Nilgiri brown and the striped neck mongoose, the Malabar civet, and the spiny mouse. The Himalayan fauna (e.g., the thar, the pine marten and the European otter) is represented high up in the Nilgiris, suggesting former links during the glacial epoch and subsequent isolation. Other mammals of the tract are the elephant, the tiger, and the panther. Due to high humidity the panther exhibits marked melanism.

(b) The South - east Tract

(Inspector-General of Forests, Retired)

This artical appeared in Cheetal Vol. 9, No.1 Published in October 1966

2.2 In the low scrub, and open grasslands dotted with xerophytic vegetation (rainfall below 30 inches). herds of gazelles and antelopes abound. The common associates of antelopes are the jungle cat, the common fox, the common mongoose, the Indian wolf, the palm squirrel, the hare and variety of field rats. In Mysore and Hydrabad, where rainfall is about 35 inches, a much richer fauna consisting of the spotted deer, the wild dog, the sambhar, the sloth bear, the Indian bison, the elephant and the hyaena, is met with. The *cheetah* (the huntind leopard) once common in this tract is now extinct.

(c) The Central Plateau

2.3 The dry type of forest of these highland supports animal life akin to the south-east tract referred to above. With the increase in rainfall (40 to 50 inches), the character of vegetation changes to what is known as the monsoon forest which is the home of the true Indian fauna comprising the spotted deer, the nilgai, the blackbuck and the four-horned antelope. These typically Indian mammals do not occur anywhere else outside India. The Indian bison, the sambhar and the muntjac occur both in India and South-east Asia. Further east of Nagpur, where moister conditions prevail, we have, in addition, the elephant, the wild buffalo and the swamp deer. The tiger and the panther occur throughout the Deccan forested areas. It never crossed into Ceylon. In the Vindhya Pradesh one comes up against albino tigers occasionally.

(2) The Indus Basin

3. The fauna of the dry and xerophytic forests of this region is reminiscent of similar forests of the Deccan. In the Rajasthan desert, however, where rainfall is of the order of 10 inches or so, one comes up against the desert cat, the desert fox, the desert hare and the desert gerbilles. On the peripheral lands, the gazelle, the muntjac and the blackbuck are common. In Junagadh. (Saurashtra) we have the remnants of the Indian lion that once frequented a large tract to the east of the Aravallis.

(3) The Gangetic Basin

4. The blackbuck and the gazelle occur in open and dry types of forests of this region. With increase in rainfall in the *tarai** and *bhabar** at the base of Himalayas the character of vegetation changes to support the swamp deer, the hog-deer, the sambhar, the spotted deer, the muntjac, the elephant, the jackal, the wild pig, the tiger and the panther. Eastward, in the North Bengal and Assam, we have the remnants of the Great One-horned rhinoceros (*R. unicornis*) and the buffalo, the counterpart of the bison of the south. In the evergreen rain forests of Assam, the fauna of the West Coast replicates itself faithfully, including melanism among panthers.

*The debris washed down by the Himalayan streams spread out in a fan formation at the foot of the mountainous region, giving rise to a waterless tract, known as the bhabar. Water that sinks in the bhabar oozes out further south giving rise to the tarai (moist) conditions in the tract where the debris spreads itself out.

(4) The Himalayas

(a) Western Himalayas

5.1 While many animals of the Indus Basin such as the blackbuck, the Muntjack and the gazelles work their way up to an elevation of upto 2,00 feet, the characteristic representative fauna of the region above is the Kashmir stag, reminiscent of the European red. The *sambhar* of the foot of the Central Himalayas is conspicuously absent. Other animals inhabiting higher elevations are the ibex, the markhor, the shapu and the snow-leopard. While the brown bear occurs in the snow ranges, lower down the black Himalayan bear is more common.

(b) Central Himalayas

5.2 The chain of low laying hills (Shiwaliks) that runs almost parallel to the great Himalayas encloses a tract known as the 'dun' (between two mountains). This tract is endowed with a rich and varied flora and fauna that has attracted worldwide attention. The tiger, the panther, the elephant, the hyaena, the sambhar and the muntjac are common. Higher up in the Himalayas, in the 5000 to 10,000 feet zone, the Central Himalayan animals like the ibex, the shapu, the markhor and the brown bear are conspicuously absent. Here, the Kashmir stag is replaced by the sambhar. The black Himalayan bear, the musk deer, the civet and the goral are common. The panther goes upto an elevation of 8,000 feet.

(c) Eastern Himalayas

5.3 In the moist Eastern Himalayas at higher elevations, the fauna assumes an Indo-Chinese character and comprises such forms as the racoon, the hog-badger, the ferret-badger, the crestless porcupine, the goral, the thamin deer and the serow. The snow leopard of the Western Himalayas is replaced by the clouded-leopard and the marbled cat.

6. It remains to be added the animals do not recognise any physical boundaries. They exhibit considerable migration not only from one region into another region but also from and into adjoining countries.

II. Wild life, a Wasting Asset

7. Wild life enjoyed in the past a measure of protection by virtue of the inaccessibility of the forest which sustained and sheltered it. The depredation of forest tribes with their traditional bows and arrows, nets and snares, drives and dogs, were hardly noticeable except on the fringes of the forest. Wild animals continued their uneventful existence until the turn of 19th century when the British appeared on the scene with their modern weapons, and what was worse, with licentious lust for killing which passed for sportsmanship those days. The wild life of the country had to contend with

an attack on two fronts. Vast forest areas that provide a haven for wild life were given away for a song to enterprising adventurers, for raising tea, coffee, rubber, and rice for labour engaged on plantations. The forest succumbed to the irresistible pressure of planters and local population, and with rifles and double-barrelled guns in the hands of trigger-happy hunters. The dawn of the twentieth century witnessed a systematic destruction of wild life brought about by the opening up of the forest, the arrival of the ubiquitous jeep and the invention of blinding flashlights. The area negotiated by the jungle folks increased as more roads were built, and opportunities for the sale of venison increased. Netted quails and partridges found favour in many fashionable restaurants in the country.

8. Unable to fend for themselves many a species were driven to the verge of extinction. The Indian Lion, which for its bravery, invincibility and regal gait, inspired the priest, the poet, and the painter alike, was wiped out of existence by the so called British sportsman of the East India Company. Upon the beginning of the 19th century, the Lion stalked the Indus Plain and the Central India Highlands covering an area of about 1/4 million square miles. By about 1850, the lion was well on the way out, despite repeated protests one reads in the sporting journals of the time,* The lion is confined today to a small tract (550 square miles), the Gir forest in Saurashtra. Like most protected monuments of the country, the lion owes its existence to the foresight of Lord Curzon the celebrated Viceroy of India at the turn of the 20th century. During the post-independence era a second home for the lion has been found in the Benares Division of Uttar Pradesh.

9. The hunting leopard (the cheetah) followed suit. Once a pet of the ruling princes in their blackbuck hunts, it is now as dead as the dodo. Its unfortunate resemblance with the wily panther proved its undoing. The Asiatic Two-horned rhinoceros (*R. sumatrensis*) of Assam, and the Lesser One-horned rhinoceros (*r. unicornis*) has been saved from the hunters of its horns, prized as valuable aphrodisiac, by declaring it as protected animal and nursing it in the Kaziranga Sanctuary in Assam and Jaldapara Sanctuary in West Bengal. In West Pakistan, the days of the straight-horned markhor are numbered. The Urial of the Punjab is like wise threatened. The wild buffalo is no longer to be seen in areas to the east of the Godavari. The pink-headed duck is gone for good. The Monal, the Tragopan and the Peacock are still with us because a rigid control on the export of their feather has been enforced.

10. It may be noted that during the last 2,000 years, the world has lost 77 species of mammals. Of these, 39% have disappeared since the turn of the 20th century (34.1). It

* The Bengal Sporting Magazine (1833-41); the sporting Review 1856; the Oriental Sporting Magazine, 1866

is not sufficiently realized that once a species, more particularly a gregarious one; begins to go downhill, its rehabilitation becomes extremely difficult and yet there is no natural resource that reacts so readily to protection as wild life, provided it is not allowed to cross the critical stage when recovery becomes difficult, if not possible.

11. In India, the following species have already entered a critical stage of their existence.

(a) Mammals

(i) Snow and Clouded Leopard.

(ii) Indian wild ass

(iii) Kashmir stag

(iv) Musk deer

(v) Markhor (Kashmir)

(vi) Thamin, The brow-antlered deer of Manipur

(vii) Pungy Hog

(b) Birds;

(i) Great Indian Bustard

(ii) Monal

(iii) White-winged duck

The list is not exhaustive. Some game animals have reached the verge of extinction in a given locality, but hold their own in another one.

III. Man and his Environment

12. The clash between the interests of Man and Animals must be resolved in a rational manner. Wild life management does by no means envisage the preservation of all animals regardless of their role in the economy of the countryside. Predators that destroy the field crops and prey upon other animals have to be kept under control. The claim of the forest which supports wild life rests on both the physical and economic grounds. Reckless destruction of the forest leads to the deterioration in the physical field which adversely affects the productivity potential of the soil. With diminishing crop returns and more and more mouths to feed, the forest has to yield to the axe and the plough for raising more food. This causes further deterioration of the physical environment and consequent diminution in crop returns from which there is no escape. The solution of India's food problem lies in intensive, not in extensive agriculture. Land use in India is to be modified, therefore, in the light of the productive, protective and social roles of the forest in the balanced economy of the

* The mammals mentioned in this edict are:- monkey, rhinoceros, porcupine squirrel, swamp deer, bull and all 4-footed animals not utilised or eaten.

country. Land is to be permanently dedicated, therefore, for the maintenance of the forest and its colourful denizens.

IV Wild life Legislation

13. The protection to wild life was enjoined as far back as the 3rd century B.C. by Emperor Ashoka. On his Fifth Pillar Edict are inscribed names of birds, beasts*, fishes and insects which were to be preserved. The Edict further ordained the protection of the forest from fires. Later, the Moghul Emperors evinced considerable interest in wild life. No one was allowed to hunt the lion except the royalty. The memoirs of Jehangir read like a treatise on wild life.

14. During the British regime the destruction of wild life at the hands of trigger happy hunters reached alarming proportions resulting in the adoption of stringent measures. In 1887, the Wild Birds and Animals Protection Act was passed. It was subsequently repealed by Act VIII of 1912. The Forest Act XVI of 1927 dealt with the regulation of hunting and fishing inside the State forests. The game laws enacted sought control over poisoning, netting, snaring and pitting of animals and birds, 'Close periods for various species were specified. Grant of licences on payment of nominal dues was introduced. A special act for the protection of elephants was also passed. Various States enacted game laws of their own, e.g., the Punjab Wild Birds and Wild Animals Protection Act of 1933; the Bombay Act XXVI of 1951, etc. In the Uttar Pradesh, the National Parks Act was passed in 1934, under which the Corbett Park was originally constituted.

15. Poachers have always been hard to apprehend and even harder to be convicted. It is necessary that the burden of proof in the case of offences against game laws should be on the defence, and punishments and penalties should be adequate to prove deterrent.

16. Prevention of killing for trade and profit constitutes the key stone of preservation. Trade in animal products should be put down with a heavy foot. It is the gun accompanied by greed that spells destruction to wild life. Birdlife has suffered considerable damage due to the deadful plumage trade. The Great Indian Bustard is on the way out. While the monal pheasant and the tragopan in the Himalayas have been saved by the ban imposed on the export of their feathers, the peacock, the black partridge, egrets, jungle cocks, paddy birds, kingfishers, jays and rollers, orioles and a host of other birds have likewise been given a lease of life by putting a stop to the lucrative trade in their feathers.

17. A special feature of the Indian game laws is that they largely relate to hunting inside the State forest. Game outside does not get similar protection due to want of an

organisation for game preservation.

V. Public Opinion

18. While there is little to be desired in the matter of enactment of game laws, there is almost an unbridgeable gap between legislation and its implementation. Reliance on deterrents,, penalties and punishments is of little avail without healthy public opinion against the insensate killing of voiceless denizens of the forest. Public interest must be aroused to the pitch of revolt against the wanton destruction of the valuable asset that India has in her colourful wild life. The cultural, ethical, aesthetic, recreational and sporting aspects of wild life deserve a wider recognition than is usually accorded. In order to mould public opinion we must begin at the beginning and catch people young. Animal stories, photographes, pamphlets, poster, films and lantern slides should be utilized in advancing the cause of wild life in schools and colleges. It is the rising generation that should be enthused with a missionary spirit in the protection of our rich and varied heritage in our wild life. It is to be noted that spirit in the protection of our rich and varied heritage in our wild lfe It is to be noted that it is public opinion in India which protects monkeys, parrots, peafowl, fish pigeons and inglai.

19. Paradoxical as it may appear, the staunchest support for the preservation of wild life comes from those who indulge in its destruction, viz. the shikaris in India and from the safaris of Africa. Everyone kills the thing he loves: the proud by possession, the poet by faint praise, the biologist by giving it a Latin name, and the sportsman with a gun. There are only two tragedies in the life of a sportsman: one not getting the trophy he wants; and the other more serious one, getting it. There is nothing so heart-rending as not getting the tiger you are after want; and yet there is nothing so heart breaking as finding the handsomest of God's creation lying at your feet reduced to stinking mass of flesh.

VI. The Bombay Natural History Society.

20. For its preservation, the wild life in India owes a debt of gratitude to the Bombay Natural History Society which through its journal and other publications has sought to stimulate public interest during the best part of 75 years. It was largely through its efforts that game laws were enacted and modified from time to time. The part played by the zoological survey of India in advancing the cause of wildlife has by no means been small. Various Games associations (The Nilgiri Game Association founded in 1879, the Bengal Fishing Association, the Madras Games Association, 1933, etc.) have exercised control on shooting and fishing and set up a standard of sporting ethics. The Wild Life Preservation Society of India, is also doing much for the cause.

VII. The London Convention, 1900

21. The genesis of the movement for the preservation of wild life goes back to the year

1900 when the British Government convened a conference in London for the purpose. This celebrated London Convention for the preservation of wild life in Africa was signed by France, Belgium, Italy, Spain, Portugal, and Great Britain. It has since come to be regarded as the Magna Carta of Wild life in Africa.

VIII. International Conference for Protection of Nature, 1913

22. In 1913, an International conference for the Protection of Nature was held in Berne(Switzerland) at which 17 countries were represented. A central organization to deal with wild life on an international plane was proposed. The World War I, however, intervened and the recommendations of the Berne Conference were not implemented until 1928 when a Central Wild Life Bureau was established at Brussels. It was called as the International Office for the Preservation of Nature: L.O.P.N.

IX The International Conference, Paris, 1931(18(2)).

23. It was as a result of the efforts of this organization that an International Conference for the preservation of wild life was held in Paris in 1931. MR. Ramsay Macdonald, the then Prime Minister of United Kingdom sent the following inspiring message to the Conference.

"In the territories for which they are responsible His Majesty's Government in the United Kingdom regard themselves as trustees for the Protection of Nature, not only in the interests of their present inhabitants but in those of the world at large and of future generations."

"The wonderful fauna and flora with which Nature has endowed the world have already suffered grave losses. Animals and plants of great scientific interest and often of great beauty have been exterminated, objects of great geological interest have been destroyed and the beauties of Nature defaced. Lovers of Nature may do much to stem the process, but if their object is to be secured the active cooperation of Government is essential"(12(1)).

X. The London Conference, 1933

24. Soon after, another international conference was held in London in November, 1933. At a dinner of the African Society held in London on November 13, Prince Leopold of Belgium observed:

"The protection of Nature raises problems of universal importance, the evolution of which cannot be left to the initiative of isolated groups whose action is necessarily limited, and who are unable to enforce in their entirety, the effective measures of preservation which are necessary.

"The State alone can and must take responsibility for a protective organization which

will command the interest of all mankind in its moral, social, economical and cultural development; and, this the political aspect of the question becomes apparent."

25. At this London Conference, India sent an observer. The deliberations of this conference aroused a great deal of interest in the protection of wild life throughout the British Empire. A Society for the Preservation of the Fauna of the Empire was formed with branches in India, Burma, Ceylon and of elsewhere. In the Punjab, new game laws were enacted in 1933; in the Uttar Pradesh the Hailey National Park now Corbett park was brought into being by an act of legislature in 1934. About the same time the Journal of the Bombay History Society sponsored a series of contribution on the preservation of wild life (24.III).

Xi The Delhi Meeting, 1935

26. In 1935, wild life enthusiasts from all over India met at New Delhi to devise ways and means for the preservation of wild life. Before the recommendations of this august meeting could get under way the second world war broke out.

XII. The I.U.C.N. 1948

27. After the cessation of hostilities as International Union for the Conservation of Nature and Natural Resources (I.U.C.N.) was set up under the aegis of UNESCO at its meeting held at Fontainebleau in 1948. It aimed at the conservation and wise use of "the entire world biotic community or Man's natural environment which includes the earth's renewable natural resources..." On September 20, 1951, at the inaugural address of the I.U.C.N. at Hague, MR. Van der Goes Van Naters summed up the situation succinctly in the following words:

"The Protection of Nature has passed from the concept of a simple establishment of reserve areas to that of a rational management of an entire region, in full harmony with natural laws. It is mixed with town planning with the science of land utilization, even with social sciences to become more and more a chapter of human ecology",

XIII The Indian Board of Wild Life, 1952

28. Nearer home, Lieut-Col. R. W. Burton entered a plea for the wild life preservation in the Journal of the Bombay Natural History Society (4). At the instance of the I.U.C.N. the Government of India appointed an ad hoc committee with the writer as its chairman, to consider ways and means for the preservation of wild life. It was on the recommendation of this committee that the Indian Board for Wildlife was constituted by the Government of India. The Resolution (No7-110/51-R dated April 4, 1952) on the subject stressed the need for such a Board in the following terms:

"India's heritage of wild life is fast becoming a vanishing asset and some of our notable animals (and birds) such as lion, rhinoceros, cheetah, tragopan are on the

verge of extinction. With a view to preserve the fauna of India and to prevent the extinction of any species, and their protection in balance with natural and human environment, Government of India are pleased to constitute and appoint a Central (later, Indian) Board for Wild Life."

The functions of the Board are laid down as under:-

- (i) to devise ways and means of conservation and control of wild life through coordinated legislative and practical measures with particular reference to seasonal and regional closures, and declaration of certain species of animals as protected animals and prevention of indiscriminate killing ;
- (ii) to sponsor the setting up of National Parks, sanctuaries and zoological gardens;
- (iii) to promote public interest in wild life and the need for its preservation in harmony with natural and human environment'
- (iv) to advise Government on policy in respect of export of living animals, trophies skins, furs, feathers, and other wild life products;
- (v) to prevent cruelty to birds and beasts caught alive with or without injury; and
- (vi) to perform other functions as are germane to the purpose for which the Board has been constituted.

29. The Board is to meet once in 2 years. It has been authorised to appoint technical committees to report on specific problems. His Highness the Maharaja of Mysore, a staunch supporter of Wild Life was appointed as the Chairman of the Board, The Director of the Zoological Survey of India as its permanent ex-officio Secretary and the Inspector General of Forests as an ex-officio vice-chairman. Three regional secretaries were appointed to look after the wild life affairs in their respective regions. Among the members of the Board were:-

1. Organisations:

- (1) Zoological Survey of India
- (2) Geological Survey of India
- (3) Botanical Survey of India
- (4) State Forest Departments
- (5) Zoological Gardens

*1. The loss of revenue involved in keeping large areas of forest unexploited is reduced by declaring only a small unit as 'sanctum sanctorum' inside a National Park or a sanctuary, where plant life may be preserved in its virgin state without any human intervention, e.g., Bandipur, Mysore, Special 'preservation plots of species of botanical interests may be constituted for the study of their evolution with or without protection of wild life, e.g., Ramnagar, U.P.

2. Nature reserves are constituted to preserve landscape areas of great scientific interests or scenic beauty. These conservation areas form a second line of defence.
Government passed the National Parks Act in 1926.

- (6) Fisheries
- (7) Bombay Natural History Society
- (8) National Institute of Science
- (9) Ministry of Natural Resources and Scientific Research
- (10) Ministry of Transport
- (11) Bengal Natural History Society

II Noted Sportsmen, keen wild life supporters and wild life enthusiasts.

30. The inaugural meeting of the Board took place on November 25, 1952 at Mysore. Ever since the Board has met every two years. Later, a Bird Wing and a Zoo Wing were added to the Board, and associate membership of the Board was created.

31. Ever since its creation, the Board has performed signal service in the cause of wild life. In States, wild life organisations have been set up that mirror the constitution of the Central organisation. In some States separate wild life organisations have been constituted. Other non-official organisations include the wild life preservation Society of India which has a magazine of its own, viz., Cheetal. At the Forest Research Institute Dehradun a wild life club has been formed.

XIV. National Parks

32. Among the various activities of the Board, the constitution of National Parks, Sanctuaries and Zoological Parks in various States has been of the greatest importance in advancing the cause of wild life. The distinction between these wild life refuges is as under:-

(1) The National Park denotes an area permanently dedicated by statute to conserve Nature in an unspoiled state* for the enjoyment of the existing generations, and that of the generations to come. The term 'Nature' connotes not only wild life but also scenery, forest and objects of nation (e.G. geological, historical, archaeological) interests.

(2) Sanctuary denotes an area declared as such by competent authority with a view to conserve wild life, in particular to nurse species threatened with extinction. Thus, the rhino sanctuary in Kaziranga (Assam), the lion sanctuary in Gir forest, the Rajaji sanctuary in Siwaliks where protection is sought generally for all animals. Very often, the rehabilitation of a species is secured by declaring it protected in a given locality. Some tracts require special protection, e.g., canal banks, water holes, salt licks where

8According to Section 9 of the Bombay Act XXVI of 1952, the following species are classed as vermin: (1) Mongoose, (2) Civet cat, (3) Wild cat (excluding tiger, lion, panther, cheetah), (4) Wild dog, (5) Wild pig, (6) Rodents (excluding hare, giant squirrel, and flying squirrel), (7) Jackal, (8) Monkey, (9) Bat, (10) Crow, (11) Birds of prey (excluding vulture). No permit is required for shooting these animals and birds. It should be remembered that they are not to be wiped out of existence. One should not forget that shark- the scourge of the sea- gave us insulin.

wild life congregates. (10(3)).

(3) In india there are 72 National Parks and sanctuaries covering an area of nearly 7,700 sq. kilometers.

(4) Zoological Parks are Gardens where animals are kept in confinement. In Zoological Parks conditions secured for housing of animals at being similar to those which obtain in their natural habitat. Large enclosures with camouflaged confirms replacement structures and revolting iron railings of the conventional zoos.

33. In the U.S.A. the first National Park (Yello Stone) was established way back in 1872 by an Act of the Congress. At present there are 28 National Parks covering an area of about 13 million acres. They are a federal concern. The National Parks service was created in 1916. Sanctuaries in the U.S.A. are know as Wild Life Refuges. In S. Africa, the Union Government passed the National Parks Act in 1926. There are at present 5 National Parks, the biggest 'Kruger' covers an area of 800 sq. miles. Switzerland has a National Park in the Engadine. Sweden has 14 National Parks. Finland and Austria have established numerous reserves for the protection of wild life. Poland and Czechoslovakia have created a common park on their border (Tatra). In the Congo, Parc National Albert was created in 1925 and Subsequent enlarged. (18(2)).

XV. The Indian Board's Achievements

34. During recent years of its existence the Indian Board for Wild Life has concerned itself with-

- (1) Declaration of protected animals and vermins* to be kept under control. Protection of breeding grounds of birds getting scarce, e.g. Great Indian Bastard.
- (2) Control of export of wild animals and its products.
- (3) Control of imports. Quarantine.
- (4) Period of rest. Close seasons.
- (5) Cooperation of leaders of public opinion, noted naturalists and sportsmen secured through membership of regional wild life associations. Appointments of Honorary Wild Life Wardens.
- (6) Revision of Game Laws with a view to prevent destruction of wild life by
 - (a) shooting with blinding flashlights and headlights;
 - (b) shooting at salt-licks, water holes;
 - (c) control of arms, particularly of crop-protection guns;
 - (d) indiscriminate shooting, limits to bags;

*The Pledge is as under:-

"Born and bred in the land of Buddha and Gandhi, I give my solemn pledge to protect our country's forests and their voiceless denizens from wanton and wasteful destruction."

- (e) snares, pits, poisoning, drives, dogs.
- (7) Drawing up model legislation for the guidance of States, e.g. National Parks Bill.
- (8) Wild Life studies.
- (9) Publicity. Education of public opinion. Pictorial charts. Pamphlets. Inclusion of wild life in schools and colleges more particularly in the curricula of forest colleges. Films. Photographs. Broadcasts. Postage stamps. Magazines.
- (10) Exchange of animals in zoos.
- (11) Care of animals in zoos.
- (12) Rehabilitation of species on verge of extinction, e.g., a new home for the lions; for the rhino.
- (13) Participation in international organizations for preservation of wild life.
- (14) Control of fishing. Provision of fish-ladders in canal dams for the migration of fish upstream.
- (16) Coordination of wild life preservation with neighbouring States.
- (17) Prevention of cruelty to animals: domestic, wild, confined.
- (18) Celebration of Wild Life Week throughout the country.
- (19) Wild Life Conservation Pledge for the Youth of the Land.*

XVI. Finance

35. Organizations set up for the wild life preservation throughout the country have one thing in common, viz., they all suffer from paucity of funds. No organization can subsist only on the enthusiasm of its supporters. Of late, both the Center and the States have shown increasing awareness of the wild life problems and have allotted funds for the purpose which could best be described as meagre, A Game Fund should be created both at the Center and in the States to which should be credited income from the following sources:

- (i) Sporting arms. Licences. Import duty on arms and cartridges.
- (ii) Game licence. Fishing permits.
- (iii) Entrance fees to National Parks, Sanctuaries, Zoos
- (iv) Fines, forfeitures and sale of confiscated animal products.
- (v) Collection during the Wild Life Week.
- (vi) Contribution from the Government.
- (vii) Sale of animals and birds.
- (viii) Export duty on animals and animal products.
- (ix) Royalties on sale of elephant caught.

37. In the U.S.A., the Game Fund was an integral part of the game and fishing laws. The rehabilitation of wild Life in Pennsylvania, which was on the way out in 1980, was largely financed by this fund. The Wild Life Restoration Act of 1937 allotted to

the States Funds, sums out of 11% excise tax levied on arms and ammunition. The Wild Commission in Malaya recommended likewise the creation of a Game Fund (24 v).

XVII. Fundamentals of Wild Life Preservation

36. For wild life protection we must have:--

- (1) Enlightened public opinion
- (2) Adequate funds
- (3) Game Laws, Deterrent penalties
- (4) Adequate staff
- (5) National Parks, Sanctuaries, Reserves, etc.

XVIII. Cultural Aspect of Wild Life

37. The cultural development of a country is not only judged by its art and architecture, philosophy and literature, but also by how it preserves its historical heritage and its natural resources. Forests and wild life should be raised to the national status of museums, operas, theatres, and architectural monuments which provide inspiration to the public, in addition to the revenue for the exchequer.